DESIGNING A MOBILE INTERFACE FOR A DEAF USER

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Abstract

My MA thesis is a collaborative research and design project about designing a mobile application to bridge the communication gap between Deaf people and healthcare professionals in South Africa. It explores health knowledge transfer problems faced by the Deaf community during a health consultation and aims to solve them by the means of a mobile application interface designed to aid communication.

Healthcare, a basic human right, is violated when healthcare professionals don't find the means to communicate health information to Deaf people in a medium that they understand. This communication problem is due to a language barrier between the Deaf and the hearing world. A Deaf person uses sign language as his or her primary form of communication, yet there is a lack of sign language interpreters at healthcare centers. Sign language is the first language of Deaf people because of which a number of Deaf communities all over the world are only able to use a very basic level of written or spoken language. Moreover, medical information is complex and the factors mentioned above make it difficult to transfer health knowledge between healthcare professionals and Deaf patients, leading to poor health conditions of the latter.

In order to solve this problem, my thesis explores ways of transferring medical knowledge using visual methods of communication as opposed to text based communication, via a mobile application. Since health knowledge is a vast topic, for my project I focus on only one medical condition, Diabetes type 2. This choice is determined by the fact that Diabetes is a lifelong condition that requires regular hospital visits and timely communication and treatment. A core aspect of my research is finding ways to design interactive interfaces that better suit the requirements of the Deaf user than they do at present, using a process of benchmarking, co-creation, interviews and usability testing. My project documents insights from desk and field research which are used to design and test a prototype of the mobile application with Deaf users in South Africa.

Keywords interaction design, deaf, healthcare, South Africa, mobile, digital media

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CONTENTS

1

Introduction

1.1 Project Background

My MA thesis aims towards facilitating communication between Deaf people and health care professionals through a mobile application. It addresses re-thinking mobile application interfaces designed for Deaf users in order to better fit their physical and cognitive requirements. During the project i designed a section of a mobile application called SignSupport to help bridge the communication gap between Deaf people and healthcare professionals in South Africa. The project was done in collaboration with the Technical University of Delft (Netherlands), the National Institute for Deaf (South Africa), University of Western Cape (South Africa) and Association for people with disability (India).

Poor communication between healthcare staff and patients is a common problem faced by the Deaf community in South Africa, especially when they have to visit healthcare facilities for diagnosis or treatment.[1] The reason for this communication gap is the functional literacy of Deaf people and a lack of sign language interpreters at hospitals. Internationally, the average reading age of a Deaf adult is that of a fourth grader.[2] This is not only due to illiteracy in developing countries like South Africa and India but also because sign language is a visual form of communication and has no connection with written or spoken language.[3] For an individual born Deaf, it is more natural to learn how to sign rather than learn written or spoken language.

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1 A. Emond et al., "Access to primary care affects the health of Deaf people," British Journal of General Practice 65, no. 631 (2015), 95-96.

2 Brian Watermeyer, Merly Glaser, and Theresa Lorenzo, Disability and social change: a South African agenda (Cape Town, South Africa: HSRC Press, 2006), 192-205

3 Watermeyer et al., Disability and social change (2006), 134-147.

Furthermore a majority of healthcare staff in South Africa do not sign or have access to interpreters while treating Deaf patients. Subsequently health information is not transferred correctly between the two parties.

1.1.1 History of Sign Support

To bridge the communication gap between Deaf people and healthcare professionals, a research team at TU Delft began designing SignSupport. SignSupport is a mobile application which is co-designed by Deaf communities in South Africa and multidisciplinary research teams including the team at TU Delft. I joined the team in 2016 as a User Experience Designer to design and develop a section of the mobile application through the means of field research, iterative design and usability testing.

The very first version of SignSupport was designed using a process of co-creation along with the Deaf community of Cape Town (DCCT). At the time, the application was designed to improve the overall scenario of health consultation. The mobile phone was decided upon as the tool for communication and transfer of knowledge. The conceptualization and implementation of the first version was carried out from 2008 through 2011 during which the mobile solution was tested with the DCCT. The results of the usability test showed that the DCCT was satisfied with the proposed solutions since it managed to bridge some predictable communication gaps. However, communication is complex and one cannot predict all possible communication scenarios. The scope of the project was thus narrowed down to something smaller; ie, dispensing medication to Deaf people at a pharmacy. Therefore the concept of *SignSupport for Pharmacy* was explored by the research teams in earlier years.

1.1.2 Prior research about SignSupport

At the moment the project is being further developed by PhD candidate Prangnat Chininthorn from TU Delft with design support from me. Our aim is to build a broader health knowledge transfer system between the Deaf and the healthcare community in South Africa, in more contexts than just the pharmacy. Prangnat's prior research resulted in the initial design exploration of *SignSupport for Diabetes Type 2*. She followed a process of co-designing with the Deaf community to develop a set of interface designs. The idea was for the app to be used by Deaf diabetic patients during consultation.

In the course of her research I joined the project to contribute toward the design, research and prototyping of SignSupport from a user experience point of view. During a hospital journey, the patient interacts with multiple people for example, the receptionist, the nurse, the lab specialist, the doctor and the pharmacist. The interaction with each individual has a different communication flow and requirements. For my project i focused on designing the doctor and patient interaction via the app while Prangnat Chininthorn designed the patient interaction with all of the other touch points mentioned above.

My project builds on Prangnat's prior research on the design and development of SignSupport for type 2 diabetes care. In my thesis I have combined research conducted by Prangnat with Deaf communities and health professionals in Western Cape, South Africa, along with my findings from field research with the Association of People with Disability (APD), India to bring a new perspective to the project. Therefore my focus has mainly been on understanding commonalities between use of digital interfaces by Deaf people from developing countries like India and South Africa, and using those insights to design a mobile interface that fits their requirements and helps them communicate.

1.2 Motivation

My motivation to develop this project was the unique target group which is Deaf people. Because the Deaf are such an interesting and complex target group, the development of such a project seemed not only essential for the benefit of the Deaf community but also challenging for me as designer.

As a user experience designer i was interested in understanding factors that mark the difference between interfaces designed for the hearing and for the Deaf. Communication is a key part of day to day life and my aim was to simplify communication for Deaf users by applying a user centered design approach. I was also interested in understanding the sensory and cognitive challenges faced when one sense of all the senses in the human body is taken away and the difference it makes if any while perceiving a digital interface. My aim was to apply these findings to design a mobile application concept and interface that not only caters to the requirements of Deaf people

but also aids knowledge transfer in a healthcare setting. At the start of the project it was decided that testing the designs with the users was essential. Being a part of a project such as this gave me the opportunity to design for day to day challenges faced by the Deaf in the field of healthcare and communication. It also enabled me to test my designs with potential users in South Africa by immersing myself in their environment. I have a background in animation, illustration and user experience design, and by joining this project i believed i could use my skills to design creative solutions to solve real world problems.

1.3 Aim of thesis

The project serves as a means of answering my research question which pertains to understanding the requirements of and challenges faced by the Deaf community when interacting with a digital interface. The goal of this thesis is to understand and illustrate the differences between designing interactive interfaces for a Deaf and hearing audience and to incorporate this research into the development and designs for the new SignSupport app. The differences in the design approach exist due to a number of factors such as cognition, cultural and language diversity between the Deaf and the hearing community, literacy and sensory abilities.[4] The factors mentioned increase the complexity of designing for the Deaf. Each member of the Deaf community experiences a combination of these factors in varying proportions. Hence the project also aspires to understand the requirements of Deaf users through field research in order to design for them.

The mobile solution SignSupport aims at solving communication problems for the Deaf in a healthcare setting. However healthcare is an extremely vast area of research. Therefore, to narrow down the scope, a specific medical condition, Diabetes type 2 was chosen (See Chapter 2.5). The mobile application aims at transferring knowledge and information about prevention, treatment and aftercare methods about Diabetes type 2 to Deaf patients both in a hospital setting as well as at their home.

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4 I. Fajardo et al., "Improving deaf users accessibility in hypertext information retrieval: are graphical interfaces useful for them?" Behaviour & Information Technology 25, no. 6 (2006).

2

The Deaf Community

2.1 ‘D’ for Deaf

In order to understand Deaf people, it is essential to understand the terminology used within the Deaf context. Conventionally, the term ‘Deaf’ written with an uppercase ‘D’ is used to describe people who identify themselves as part of a cultural and linguistic group of people in which deafness is not looked upon as a shortcoming, but instead as an identity.[5] People from this social group are usually born with loss of hearing and communicate using sign language. On the other hand, the term ‘deaf’ with a lowercase ‘d’ refers to people who are hard of hearing or have suffered hearing loss after birth.[6] People from this social group may or may not identify themselves with the Deaf community. Hereafter, the thesis document will follow the convention associated with the two terms.

Over the years, the Deaf community has formed its own culture that is no different from any other culture with a strong linguistic identity. In the Deaf culture, Sign Language, be it American Sign Language (ASL), South African Sign Language (SASL) or any other dialect of sign language, is the primary form of communication. Like any other culture Deaf people have a strong cultural solidarity, so much so that the birth of a deaf baby is celebrated by Deaf parents and a Deaf person prefers to have a Deaf partner.[7] It is this section of people, the Deaf community, towards whom this thesis project is targeted.

2.2 Deaf community and Sign Language

Deaf communities exist all over the world and are marked with slight differences in terms of culture and communication. Even though

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5 Watermeyer et al., Disability and social change (2006), 134-147.

6 Ibid.

7 Edward Dolnick, Gluhi kao posebnas kultura = Deafness as culture (Boston: The Atlantic, 1993).

sign language is the main form of communication used by Deaf communities across the world, there are differences in the sign language itself. During this project the team worked with a small part of the Deaf community in South Africa and India. In South Africa, the Deaf community adheres to a similar culture as described earlier (2.1). South Africa has declared eleven languages as the official languages of the country. SASL, not yet a twelfth national language, has been recognized by the constitution as a language necessary for education.[8] SASL like all other sign language systems is as complex as learning a written and spoken language. Sign language is used among deaf communities to express all the emotions that can be expressed in any other language. One can tell a joke or flirt using sign language as easily as they can in written or spoken language. The main difference compared to other languages is that sign language is conveyed via hand gestures and facial expressions and perceived using the eyes thus making it a primarily visual form of communication.[9]

The use of SASL can be found among all sections of society in South Africa and is more widespread as compared to the use of Indian Sign Language (ISL) in India. ISL is derived from British Sign Language and used to communicate by the deaf in India. In India, 6.3% of the population suffers from hearing loss. Although the Indian Deaf community shares similarities with that of South Africa there is only a small percentage of the hearing population that engages in learning and teaching ISL.[10] According to the National Association for the Deaf (New Delhi), there are only approximately 250 certified sign language interpreters available for a population of about 18 million deaf people in the country. The lack of interpreters limits the learning and growing potential of the Deaf in India.

To a hearing person, language comes naturally since childhood and is often taken for granted. However, growing up without a language can limit a Deaf individual's access to the world depriving him of his fundamental right to communicate.[11] Therefore it is important to

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8 Claudine Storbeck and David Martin, "South African Deaf Education and the Deaf Community," American Annals of the Deaf 155, no. 4 (2010).

9 Watermeyer et al., Disability and social change (2006), 134-147.

10 Suneela Garg et al., Deafness: Burden, prevention and control in India. The National medical journal of India (2008), 79-81.

11 Marion Heap et al., "Can we talk about the right to healthcare without language? A critique of key international human rights law, drawing on the experiences of a Deaf

teach and use sign language among Deaf communities as it enables them to interact confidently in a social setting.[12]

2.3 Functional literacy among Deaf people

It is a common misconception that if a person is Deaf, he or she is able to read. If a person is deaf since birth or a very young age, it becomes difficult for them to learn a written or spoken language. For example, a deaf child can only try to mimic lip formations and create sounds without any direct feedback. Since a lot of word formations look similar on the lips but have completely different meanings or uses, learning a language in the case of a Deaf person requires a lot of guesswork.[13] As a result, a majority of Deaf people do not engage in learning a language other than sign language.[14]

Illiteracy among Deaf people poses a problem while they interact with any form of hypertext or digital interface that is largely dependent on text heavy information. It has been observed that users apply their semantic memory to interact with an interface.[15] However, most digital interfaces are built based on the semantic memory of a hearing audience. In other words, digital experiences are not accessible to a wide variety of audiences. My thesis explores ways to design a better user experience for the Deaf based on their cognitive and cultural background.

2.4 Deaf people and healthcare

Access to healthcare is a primary right of every human and problems in communication with health care facilitators takes away this right from a lot of Deaf people.[16] Most hospitals lack staff that can sign, or sign language interpreters available on demand. As a result, Deaf people not only have trouble communicating their needs to healthcare staff but also understanding diagnosis and medical terminology. Inability to communicate in their own language limits a

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woman in Cape Town, South Africa," Disability & Society 28, no. 1 (2013)

12 Watermeyer et al., Disability and social change (2006), 134-147.

13 Dolnick, Deafness as culture (1993).

14 Watermeyer et al., Disability and social change (2006), 134-147

15 Fajardo et al., Deaf user's accessibility (2006).

16 Heap et al., Right to healthcare, (2013).

Deaf person's informational knowledge about health care. My project tries to solve this problem by building a digital health knowledge transfer system using a method of communication with which the Deaf community is familiar.

The health knowledge transfer system is based on the idea of educating people about various topics, including healthcare. Since healthcare is a vast topic, the research team has narrowed down to one case study - Diabetes type 2, in order to fit the project in the scope of the thesis. The reason for choosing Diabetes as a starting point of transferring health information is that Diabetes is a lifelong condition. It cannot be cured completely; however, it can be controlled by appropriate self management thus making it essential for patients to understand methods of treatment and aftercare. Diabetes type 2 is caused by the body's inability to break down glucose well to create energy. The body produces a hormone called insulin which enables this. However, when a person suffers from Diabetes type 2, the insulin is not used appropriately to breakdown glucose, leading to a high level of sugar in the bloodstream. The condition causes symptoms such as constant tiredness, frequent urination and sudden gain or loss of a large amount of weight. In order to control the condition, the patient is required to manage his diet and consume a prescribed amount of insulin on a daily basis.[17]

2.5 Deaf people and Diabetes

Deaf people are known to have poorer health than hearing people given that they do not have adequate access to healthcare.[18] As a result they are more prone to suffering from medical conditions like Diabetes and high blood pressure which develop in the human body without notice. Deaf people aren't diagnosed correctly due to communication barriers subsequently neglecting symptoms they might be experiencing. Studies conducted in UK show that even the Deaf people who are diagnosed have been tested with high sugar levels, which means that they were not provided adequate treatment to begin with.[19] A condition like Diabetes type 2 requires timely

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17 "JEMDSA 2012 Volume 17 Number 1," Journal of Endocrinology, Metabolism and Diabetes of South Africa 17, no. 1 (2012).

18 Kuenburg et. al., Health Care Access Among Deaf People, The Journal of Deaf Studies and Deaf Education, Volume 21, Issue 1, 1 January 2016, Pages 1–10,

19 Pauline Heslop and Sophie Turnbull, Research into health of Deaf people, (2013), 5-8.

treatment and management in order to keep it under control. Due to poor communication between Deaf patients and healthcare staff this knowledge is not properly transferred to the patients. Unfortunately there is not enough literature about percentage of Deaf people being diagnosed with Diabetes in South Africa. In South Africa, Deaf people do not acquire the same amount of health information as other people. Most information provided is about HIV since it is highly prevalent in the continent and very little information is available to the Deaf about other conditions like Cancer, high Cholesterol or Diabetes.[20] Surveys about information that Deaf would like to receive shows that Diabetes is on top of their list of health conditions to know about.

20 Janis Kritzinger, Health Care Information, Exploring the barriers and facilitators to health care services and health care information for deaf people in Worcester, (2011) 85-95.

3

The Case

3.1 Problem Definition

To begin designing a solution, all the research was organized into a mind-map (Figure 1) in order to identify the problem area. To further define the problem a Design Impact and You (DIY) toolkit was used.[21] The tool-kit consists of four questions of which three that were most relevant to my case were answered (See page 22). This exercise

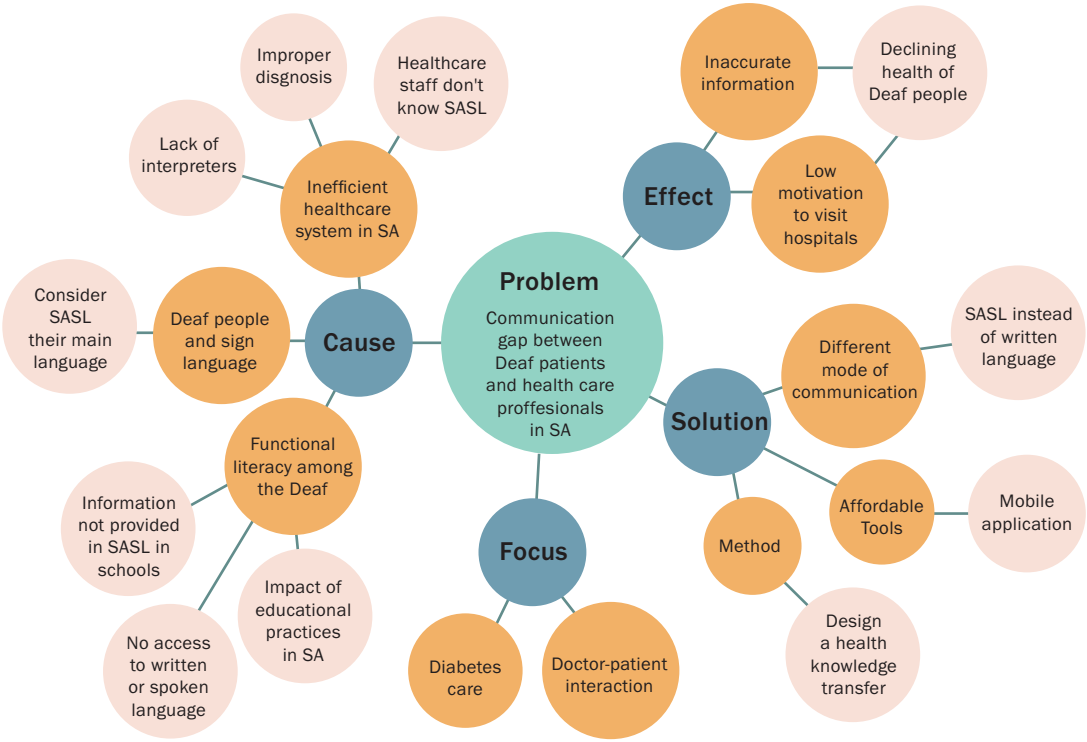

Figure 1: *Research mind-map*

21 *Lucy Kimbell and Joe Julier, The Social Design Methods Menu (2012), 29-30.*

helped put the different areas of the research into perspective and define the main problem. Research into the history of SignSupport and Deaf people's lifestyle, culture and healthcare access thus revealed a significant problem among Deaf communities in South Africa.

PROBLEM DEFINITION

"There is a huge communication gap between Deaf people and health care professionals in South Africa which prevents transfer of health knowledge between the two."

QUESTIONS FROM THE DIY TOOL-KIT

Q. What is the key issue you are trying to address (aka problem definition)?

There is a huge communication gap between Deaf people and health care professionals in South Africa which prevents transfer of health knowledge between the two. As a result many Deaf individuals are deprived of appropriate health services.

Q. Who is it a problem for? What cultural factors shape this problem?

This is a problem for the Deaf community in South Africa. This gap is due to a combination of illiteracy among the Deaf as well as a lack of sign language interpreters in public health facilities. The transfer of any form of complex knowledge, especially in the field of healthcare is hindered due to a lack of coherent communication. The act of communication requires a receiver and a sender of information and has elements of unpredictability.[22] Furthermore, medical information

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22 Le Guin Ursula K., The wave in the mind: talks and essays on the writer, the reader, and the imagination (Boston: Shambhala, 2004), 185-188

uses complex terminology which is difficult to understand not only for a person lacking knowledge of a written language but also for one who is well versed with it. This problem has a direct effect on the confidence of Deaf people when visiting healthcare facilities, resulting in fewer people visiting hospitals when they are faced with a medical condition, naturally leading to poor health.[23] Not only does this affect a deaf individual's well being but not having access to medical information also deprives Deaf people off basic health rights.[24]

As a result of the communication gap mentioned, Deaf patients in South Africa have very little understanding of complex medical conditions like Diabetes, its symptoms, effects and treatment(). For the scope of my thesis the design of the application focuses on bridging the communication gap while treating patients with Diabetes type 2. Next I formulated two main research questions from the problem definition and followed a user centered design process to answer them within the scope of the project.

RESEARCH QUESTIONS

1. How can health knowledge be made accessible to the Deaf community?

2. How can mobile interfaces be designed to better suit the needs of the Deaf community?

These questions were based on the desk and field research carried out by me in India, and previously by Prangnat Chininthorn in South Africa. Since sign language is a visual form of communication it has little to no dependence on written language. It is a common misconception that sign language is a signed version of written or spoken English.[25] ***Thus, there lacks an information exchange platform that presents information in a visual format for a Deaf audience.***

3.2 Solution spaces

Patients suffering from medical conditions such as Diabetes type 2 require accurate and timely information about precautions, treatment and aftercare, and the inability to communicate with ease makes the exchange of this knowledge challenging. By answering the research

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23 Chininthorn et al., Design direction analysis for a health knowledge transfer system for Deaf people and Health professionals in Cape Town (2015).

24 Heap et al., Right to healthcare, (2013).

25 Chininthorn et al., Design direction analysis (2015)

questions my aim was to re-think the way mobile app interfaces are used by the Deaf. By making this change the application could be better used to transfer health knowledge to Deaf users in a way that suits their requirements.

3.2.1 Using mobile as a tool for communication

Research question 1 was answered by the team at TU Delft through user research in South Africa done by Prangnat Chininthorn. The research team proposed a concept to build a mobile application that can be available free of cost to the Deaf communities in South Africa. The idea was to use off the shelf technology to communicate health information to the Deaf. The mobile application would act as a library of health and personal information and enable communication in more ways than one such as through video, visuals as well as text.

The smart-phone, a tool off the shelf is easily accessible to everyone today. Android smart phones are available in all price ranges making them accessible to the Deaf from all stratas of society.[26] The most effective way to communicate with a Deaf individual is by using sign language.[27] The mobile phone as a tool allows easy sharing of video and image based content as well as send signals or alerts through the use of vibration or flashlights. It is a portable tool and enables the user to have access to information on the go. The multi-functionality of the mobile phone makes it a valuable tool for Deaf people. It allows them to communicate on the go which was not possible before it's invention.[28]

The smart-phone is not only accessible but also an increasing part of everyday life. Other than a tool used for communication and navigation, its advantages have already been seen in the field of medicine, a common example being clinical decision support system (CDSS). CDSS is an electronic health knowledge system used by healthcare professionals via a mobile phone to assist them during patient visits to generate patient specific health advice. It helps healthcare professionals generate an electronic history and diagnosis which improves legibility and accuracy of data, and enables easy

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26 Chininthorn et al., Design direction analysis (2015).

27 Watermeyer et al., Disability and social change (2006), 134-147

28 M. R. Power, "Everyone Here Speaks TXT: Deaf People Using SMS in Australia and the Rest of the World," Journal of Deaf Studies and Deaf Education 9, no. 3 (2004)

sharing.[29] Its numerous applications in everyday life make the mobile phone a low cost multi-functional tool for communication.

As the concept was detailed further it was decided that the patient would share his or her phone with the doctor during the consultation in order for the doctor to select relevant information for the patient to view. Any information that the doctor selects or enters for the patient would be available in the form of SASL videos on the patient's phone.

3.2.2 Improving the mobile application experience for the Deaf

Research question 2 was answered through means of desk and field research using a user centered design approach. This meant involving members of the Deaf community to co-create a mobile interface that helps users understand information in a way that is most familiar to them. The aim was to understand the cognitive, physical and cultural factors that influence the way a Deaf user uses an interface and the mobile phone itself. Additionally we wanted to take into account the requirements of Deaf people with low literacy levels while visiting a hospital space and while using a mobile application. Research was carried out among two Deaf communities, one in India and one in South Africa and the insights from the research were used to design the latest version of the application. The insights from this research form the basis of the ultimate product. The idea was that the designs would then be discussed with a team of programmers from the University of Worcester for further development in the second quarter of 2018.

29 Yaw Anokwa et al., "Design of a phone-based clinical decision support system for resource-limited settings," Proceedings of the Fifth International Conference on Information and Communication Technologies and Development - ICTD 12, (2012).

4

Research Methods

4.1 Benchmarking

According to the Oxford Dictionary of Business and Management, benchmarking is the process of 'identifying the best practice in relation to products and processes.' In the case of my thesis, Benchmarking refers to comparing other mobile applications designed to solve communication problems for the deaf and drawing inspiration from them. On further research, i found that here are not many knowledge transfer apps for the deaf. Most apps available on the market assist deaf people in learning sign language. A few others help convert sound (voice) to text so that it can be read by a deaf person. However, most of these apps are based on the assumption that deaf people have high reading and writing skills. Following are mobile applications that were researched on a few criteria.

4.1.1 Apps for deaf people

NAME OF APP	PURPOSE	RELEVANCE TO THESIS
Ava (Figure 2)	Communication using voice to text conversion	Is an app that simplifies communication
DeafWake (Figure 3)	Receive alerts about day to day events (eg; turning the oven off.)	Isn't used to transfer information, nevertheless uses non text or video based methods of communicating a message
Glide (Figure 5)	Video chat app	Enables deaf users to make use of sign language videos instead of text messaging to communicate with each other

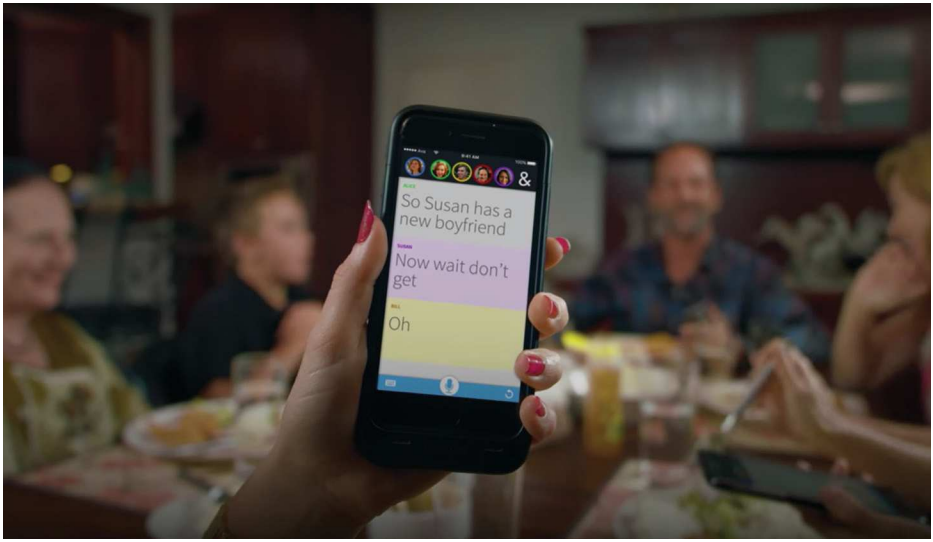

Figure 2: *Ava app for the deaf, digital image, accessed 03 March 2018, www.blog.ava.me*

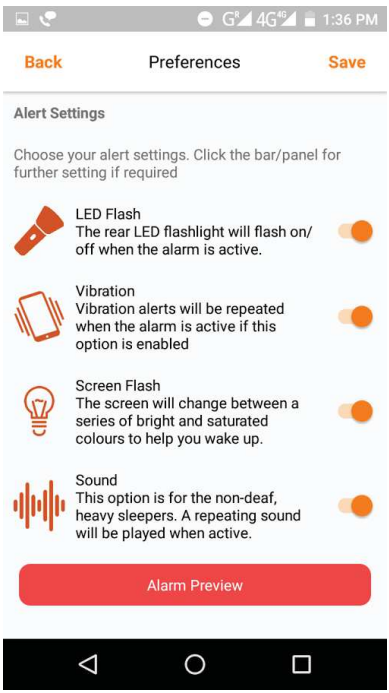

Figure 3*: DeafWake screenshot*

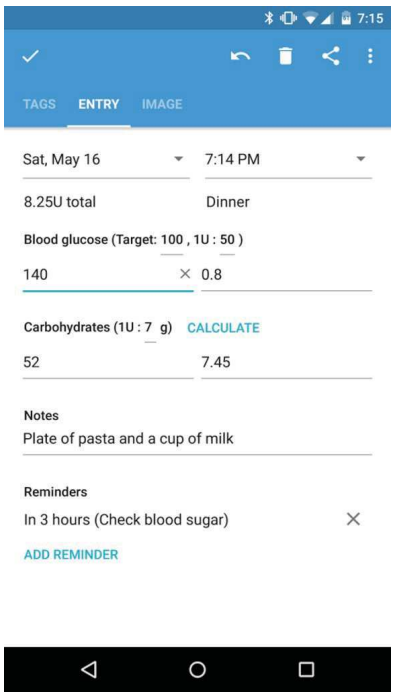

Figure 4*: Bg-monitor screenshot (recording food intake)*

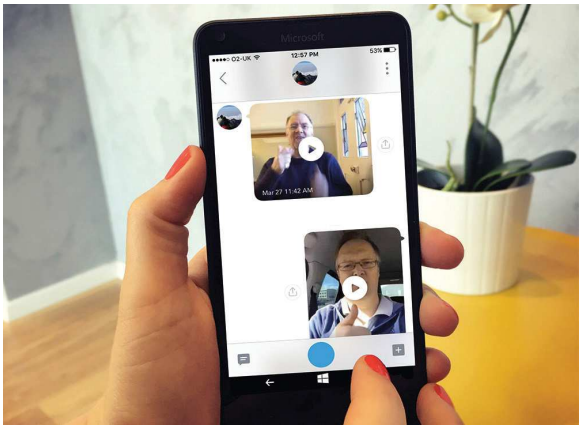

***Figure 5**: Glide, digital image, accessed 03 March 2018, www.glide.me*

4.1.2 Apps for Diabetes

NAME OF APP	PURPOSE	RELEVANCE TO THESIS
Bg monitor (Figure 4)	Tracks your blood glucose levels	Has a tracking, reminding and suggesting feature which could be useful for SignSupport
Glucosio	Open source app for tracking glucose and other metrics	Compares terms and metrics used for Diabetic medicines

4.1.3 Apps for providing medical information

NAME OF APP	PURPOSE	RELEVANCE TO THESIS
Visual anatomy lite (Figure 5)	View the human anatomy on a rotating 3D model	Uses a visual representation of the human body. Uses more images than text
Medscape (Figure 6)	Sharing medical information about drugs, condition, procedures etc	Uses visual (photo) and written methods sharing of health information. Has a visual pill identifier function that uses shapes, colours and photo identification to help users know about their medication

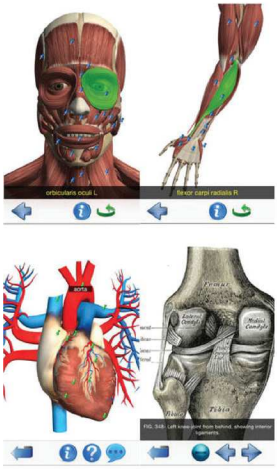

Figure 6: *Anatomy lite screenshot of body part selection screen*

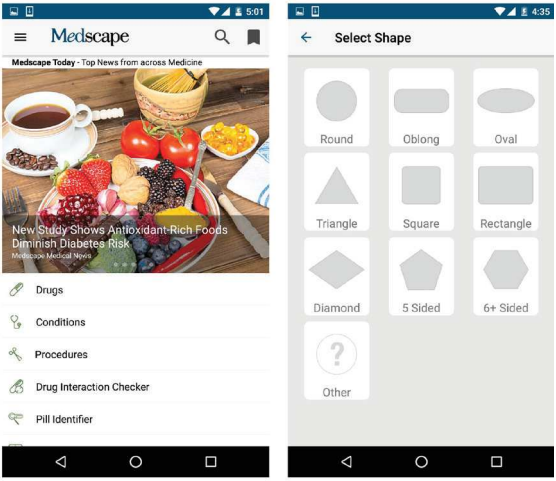

Figure 7: *Medscape screenshots of pill identifier screens*

4.2 Field research

Field research was conducted first in India, then in South Africa. Research was conducted in India as opposed to the Netherlands because of the similarity in the hospital journey of a patient in India (Figure 8a) to that in South Africa (Figure 8b). Moreover, there was a keen interest by the research team in cultural similarities between the deaf communities of developing countries like India and South Africa. The field research consisted of two parts. The first was a co-creation workshop to understand experiences of Deaf people when visiting the hospital. The second was a usability test which was conducted after the mobile application interface had been designed and prototyped.

4.2.1 Co-creation with Deaf people

Co-creation refers to designing along with the potential users or stakeholders of a project. It typically involves bringing the potential users of a product, concept or service into a room and conducting a series of activities with them to generate ideas for further designing the product. The goal of a co-creation workshop is to take into account the users' requirements and incorporate them into the design of the product. The workshop was conducted at the

Association of People with Disabilities (APD) in Bangalore, India over two days. The association provided a Sign Language interpreter and invited 4 participants who were either hard of hearing or deaf, for the purpose of my research. The workshop (described in Chapter 5) consisted of short activities setup over a total of 3 hours which were recorded and transcribed after the workshop (See Appendix A).

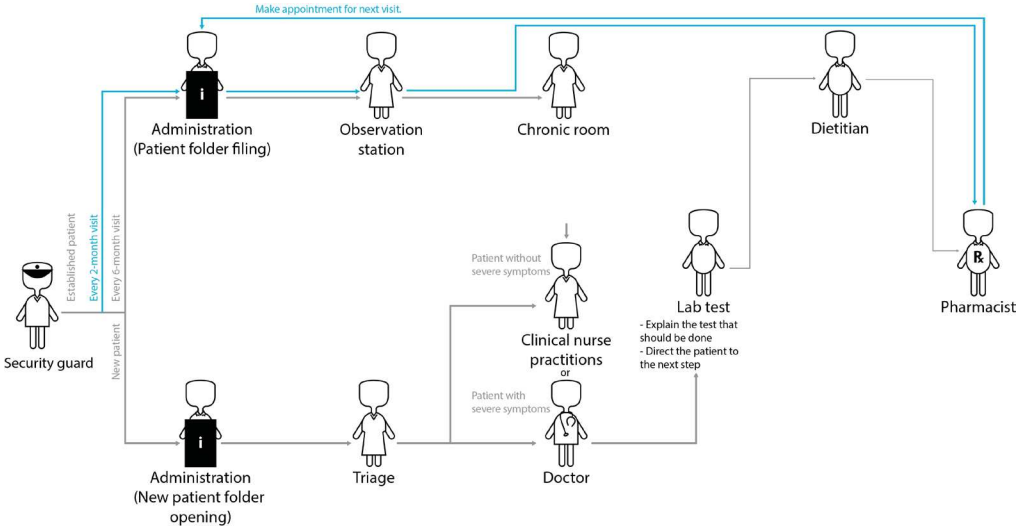

***Figure 8a**: Patient journey map of patients in South Africa by Prangnat Chininthorn*

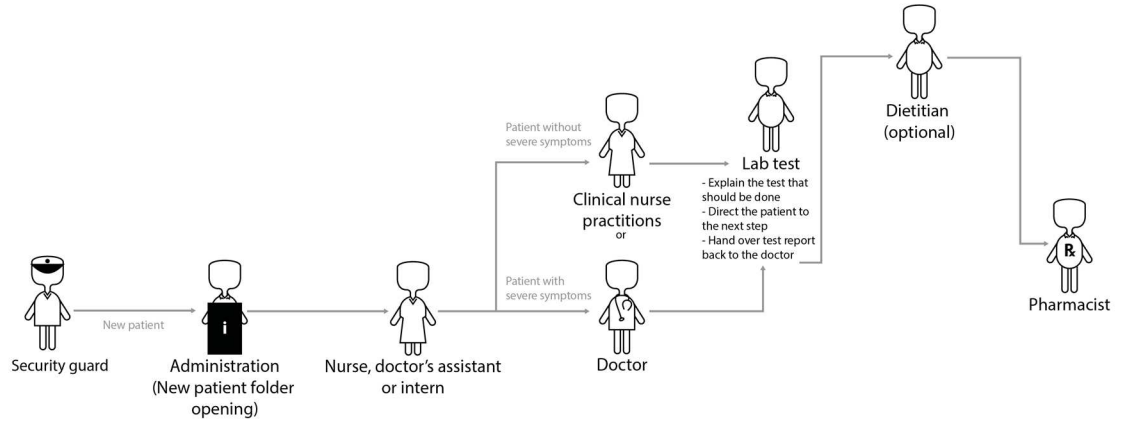

***Figure 8b**: Patient journey map of patients in India*

4.2.2. Usability testing

Usability testing is typically performed after a design is ready. It is the process of observing potential users while using a design as they would in their natural environment and interviewing them about the choices they make during this process. In this case the first designs of the app were shown to 6 participants at National Institute of the Deaf (NID) in Worcester, South Africa. The participants were asked to use a basic digital prototype of the app and give feedback about their experience and the understandability of the design. The usability test (described in Chapter 8) was conducted over two days and the process and results were transcribed after (See Appendix B).

Pilot testing

Before conducting the usability test two pilot tests were conducted. One with my advisor and one with a UX designer. Pilot testing was done to review the procedure, steps and tasks involved in the usability test. After the pilot test a few changes were made to the order of tasks and introduction of the tasks. Example, instead of directly asking the participant to use the prototype, he/she will be told a story about the persona and asked to imagine himself/herself as the persona.

5

Co-creation and it's findings

5.1 Setup and Goal

The workshop took place in a classroom at APD. Four students (all male) between the age of 18 and 24 participated in the session over two days. The conversation was interpreted by Shailaja, a professional sign language interpreter and employee at APD who was assisted by a student (who chose not to participate). The workshop was facilitated by me and additional help with notes and role playing was provided by Roshni Mistry and Nayantara Surendranath.

Goal of co-creation workshop

The co-creation workshop had two goals. One was to get a better understanding of a Deaf person's hospital journey by learning about their positive and negative memories of visiting the hospital. By doing so the aim was to note the pain points of a Deaf person's hospital journey and ideas about improving the process. The other was to know the participant's understanding of Diabetes type 2 and note the frequently asked questions or misconceptions about the condition.

5.2 Method

The workshop consisted of three tasks held over the period of two sessions, one and two hours respectively. The one hour session on Day One started with introductions, familiarizing the participants with the project and a memory recalling activity. The two hour session on Day Two consisted of two activities. The process of both days is described as follows.

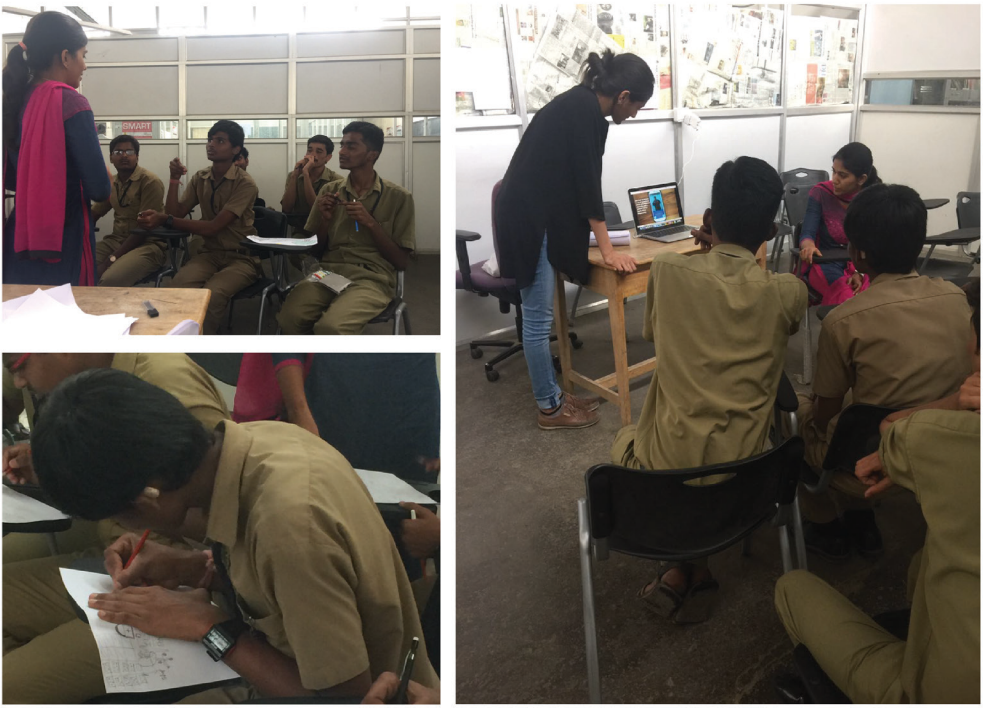

***Figure 9**: Co-creation workshop participants interacting with the interpreter*

5.2.1 Day One

Introductions - The workshop started with a brief introduction of the project and a demo video of the original SignSupport app.

Soon after each participant was asked to narrate their latest memory of visiting a hospital. Follow up questions regarding their experience at the hospital were asked in order to get a detailed understanding of problems they face. The session ended by asking the participants to think about their hospital journey and how it could be improved.

5.2.2 Day Two

Hospital journey mapping - The participants were provided with blank paper, pencils and felt pens. They were asked to draw the hospital journey that was discussed on the previous day with any improvements they might have thought of. Later they were asked to explain their sketches with the help of the interpreter.

Doctor-Patient role playing - The participants engaged in a role playing game. One of the facilitators played the role of a doctor. The participants queued up for their turn to see the doctor. All of them

***Figure 10**: Sketch of a hospital emergency by a workshop participant*

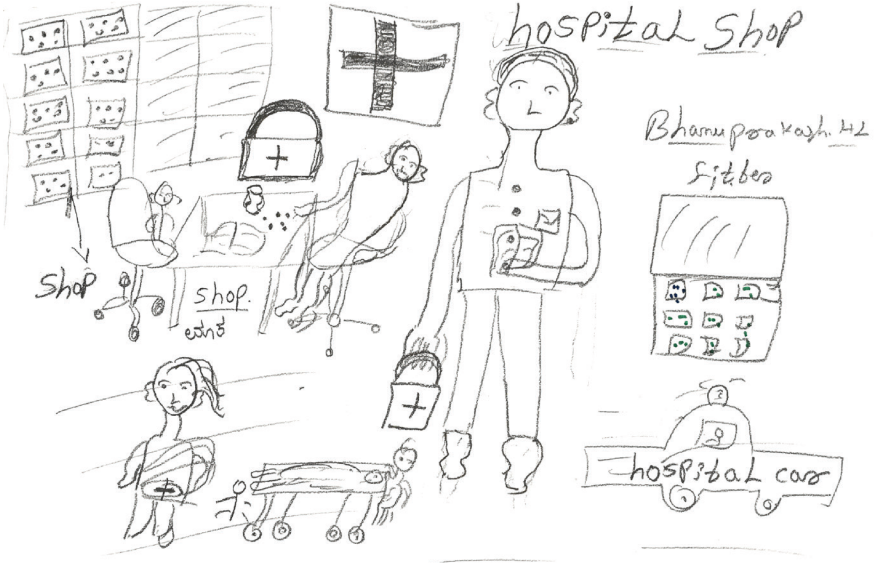

***Figure 11**: Sketch of a doctor assisting a patient at a pharmacy made by a workshop participant*

were given an imaginary situation to enact. They were asked to imagine that they suffer from a list of symptoms (those of a Diabetic person). The participants were then asked to pretend as if they were seeing the doctor one by one. During their visit the doctor informs them that they have been diagnosed with Diabetes type 2 after which the participants were asked to put forth any three questions (related to their diagnosis) that came to their mind after hearing their diagnosis. These questions were noted and later formed the basis of the Q&A section of the mobile app designs.

5.3 Results

Observations from the workshop were about the following.

1. Experience of Deaf people visiting hospitals in India - 3 out of 4 participants mentioned on Day One, that they had never visited the hospital alone. This shows dependency of Deaf people in India on their family members.

2. Experiencing a hospital journey - 2 out of 4 people mentioned that they did not enjoy visiting the hospital because of the communication gap and because no-one signed. The other two did not express strong negative feelings towards their hospital visits. One of the two mentioned that he could get by with writing his symptoms for the nurse; however, the process was time consuming.

3. Knowledge of diabetes - The go-to explanation of diabetes used by the interpreter was a 'condition with high sugar.' The participants' understanding of diabetes was very basic. They referred to diabetes as a condition in which the sugar level is high in the blood and on asking further did not know details about the condition or it's symptoms.

4. Importance given to facial expression - As observed on Day Two (Appendix A), Deaf people prioritize facial expressions in order to understand each other. 3 out of 4 participants mentioned the importance of video chat and using emoticons to express themselves and to see the way that others express.

5. Questions about diabetes - In the final exercise on Day 2, the participants asked questions that highlighted the topics of health that they were curious about. Eg: 3 out of 4 participants were curious about how their diet would change if they were diagnosed with diabetes. 2 participants also expressed interest in the method and time of medication consumption.

6. Familiarity with mobile apps - All participants used mobile applications daily. 3 out of 4 preferred using the mobile phone to communicate via video chat services. Popular apps like Facebook and Whatsapp were used by all.

7. Other problem areas - Apart from the problem of poor communication between the patient and the health care staff, the participants also highlighted two more scenarios which could be improved. On Day Two, exercise 2; one participant drew a medicine shop and explained that it would help if the doctor would accompany him to the pharmacist to help understand what medicines to buy. Another participant drew an accident scene and explained that he would not know who to communicate with and how in the case of an emergency.

6

Designing interfaces for the Deaf

6.1 Challenges faced by a Deaf user

The co-creation workshop helped understand a Deaf user's familiarity with mobile apps and addressed problems faced by them not only while visiting hospitals but also while communicating using mobile phones. User Experience (UX) for digital products is seldom carved out for users who are Deaf. Most interactive media such as mobile applications or product interfaces today are designed for hearing people. Minorities such as the Deaf or disabled are often not considered at all even though they are required to interact with the same touch-points during a user journey. One of the reasons such products are inaccessible is that digital interfaces and hypertext have text based information and require the user to possess the ability to read and write.[30]

Beyond the healthcare context, a good example of such a user journey is the train station. During travel a person is required to book tickets online or buy a ticket at the station, find the right platform and train information usually displayed on digital sign boards and finally exit at the right station. All these steps involve understanding a sequence of information which is difficult for Deaf users if not presented in a format familiar to them.

6.2 Deaf user centered approach

One of the most basic ways of interpreting information on an interface such as web, is by comprehending image and text.[31] What

30 Fajardo et al., Deaf user's accessibility (2006).

31 Ibid.

makes accessing this information even more efficient is if it can be comprehended in a short period of time. Interacting with an interface is ‘a process of parsing, focusing, comprehending and selecting information’ as described by a comprehension-based model of web navigation developed in the year 2000.[32] Since sign language is a visual form of communication, the method of comprehending information used by the Deaf is different from that of the hearing.

Mykelbust’s quote, in the book Deaf Cognition suggests that Deaf people grow up to have experiences very different from hearing people, and that the absence of one sense alters the integration and function of the others. Likely, due to this absence, experience is constituted differently, altering their world of perception and imagination.[33] Such differences create the need for researching new methods of designing. From my desk and field research insights i compiled five focus points which can be used while designing for the Deaf. These methods aim towards improving a Deaf user's experience when interacting with a digital interface.

1. Using SASL to communicate

Sign Language is the primary form of communication used by Deaf people, therefore information should be provided in a format they understand best to avoid miscommunication. All complex explanations of medical conditions, precautions and treatment should be provided in sign language. Wherever written language is used, simplified text should be used instead of over complicated sentences or words. Results of the co-creation workshop show that even though written communication occasionally worked in a hospital setting, information was lost in translation when there was no signing involved.

2. SASL: A visual format

One of the methods of creating more efficient interaction between Deaf users and an interface is to use images rather than text. Fajardo et. al discuss the phenomenon of Picture Superiority also known as

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32 Muneo Kitajima et al., "A Comprehension-based Model of Web Navigation and Its Application to Web Usability Analysis," People and Computers XIV — Usability or Else!, (2000).

33 Marc Marschark and Peter C. Hauser, Deaf cognition foundations and outcomes (New York: Oxford University Press, 2008).

the Picture Superiority Effect. An image evokes a verbal interpretation easier than a word evokes an image, thus making it easier for the Deaf to identify with information and improve performance while using a web interface. Although an image is easy to comprehend, its effect on the user changes based on factors such as location, distinctiveness and visual grouping.[34] Thus, for an image to be comprehended quicker, users need to use their semantic memory to access various parts of the interface. Semantic memory is memory acquired throughout our lives. This also means that when using visuals on the interface, one must keep in mind the visual language and symbols the Deaf associate with in their daily communication. Furthermore, observations from the workshop that deaf people prefer using video and emoticons to communicate further solidify this research.

3. Navigation

Another method that can potentially enhance the digital experience for a Deaf user is using a smaller path length when designing a graphical interface. A path length in a web interface is a term used for the number of steps taken by the user to reach the target link. If the path length is too long, a Deaf user is easily disoriented, taking a much longer time to find the target.[35] An experiment performed by Fajardo et. al shows that a longer path length pressures the user to use more semantic memory and associative memory especially in the case of a graphical interface. This is because a longer path length requires the users to draw connections between each step before reaching the target. The results also showed that in a graphical interface images are comprehended faster, yet drawing connections between two images can seem far more ambiguous than drawing connection between two words.

4. Focal point

Deaf people rely heavily on visual information. As a result, they have better developed peripheral vision than hearing people.[36] In case of a cluttered environment, a Deaf user is distracted easily. Thus, an

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34 Fajardo et al., Deaf user's accessibility (2006).

35 Ibid.

36 Sven Noben, Sign Language Media: An Exploration of Flemish Deaf Culture, Media Exigencies and Cross-Medial Perspectives, (2013).

interface for the Deaf should have a clear focal point preferably in the center of the screen instead of a large amount of information spread across the screen. Similarly information should be broken down into heading, image and content instead of using large blocks of text.

5. Content relevancy

Finally, the content in the app should be as per the experiences, cognition level and knowledge of the Deaf user. For example, complex medical terminology can be simplified to provide better understanding for users without a vast medical knowledge. In the case of my thesis, the question and answer section of the mobile app was designed after co-creation with Deaf participants (Chapter 5, 5.2) by understanding their motivation to use and expectation from such a product. Furthermore the text on the buttons was simplified to words like 'Yes', 'OK' or 'Done' to cater to users that had limited reading skills.

The five points stated above later formed the basis of the interface designs. It must be kept in mind that these techniques can be applied to a design that is aimed only at Deaf users. A design that is meant for a larger audience of which Deaf people are only a small part would not benefit from all of the above points. In such a case techniques that make digital products more accessible should be applied, for example; using captions with videos that have audio or using simplified text.

7

Design Process

A user centered design process was followed in order to create the designs. It involved detailing the concept, drafting design ideas and wireframes, color research based on benchmarking and color theory, finalizing designs and user interface, prototyping some design flows, and finally testing the designs with the user.

7.1 Finalizing the concept

During a hospital journey there are a number of people that a patient has to communicate with. The app would have different sections for different people with whom the patient interacts. For example, when interacting with a pharmacist, the interface would allow the user to access features such as the camera to take photos of the medicine whereas while interacting with the doctor, the interface would prompt the user to pass the phone to the doctor from time to time to enable the doctor to advise the patient. I designed the section in which the patient interacts with the doctor. The patient uses the app on his or her mobile phone. He/she shares the phone with the doctor during the consult by passing it to the doctor when indicated. Passing the phone back and forth, enables the doctor and the patient to communicate without an interpreter. The doctor enters or selects information for the patient which in turn is viewed by the patient in the form of SASL videos.

USER GOALS

1. To be able to understand relevant health information.

2. To be able to ask the doctor questions regarding the information received.

3. To have access to health information outside the hospital.

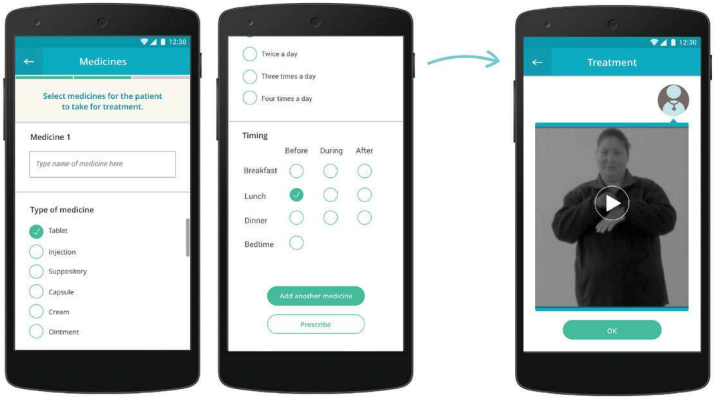


***Figure 12**: Medicine form filled by doctor is viewed as medication instructions in SASL by the Deaf patient.*

7.1.1 Final Application Flows

A number of design drafts were created and reviewed. Finally the Deaf user centered approach discussed in Chapter 6 (6.2) was applied to the design process while creating the screens.

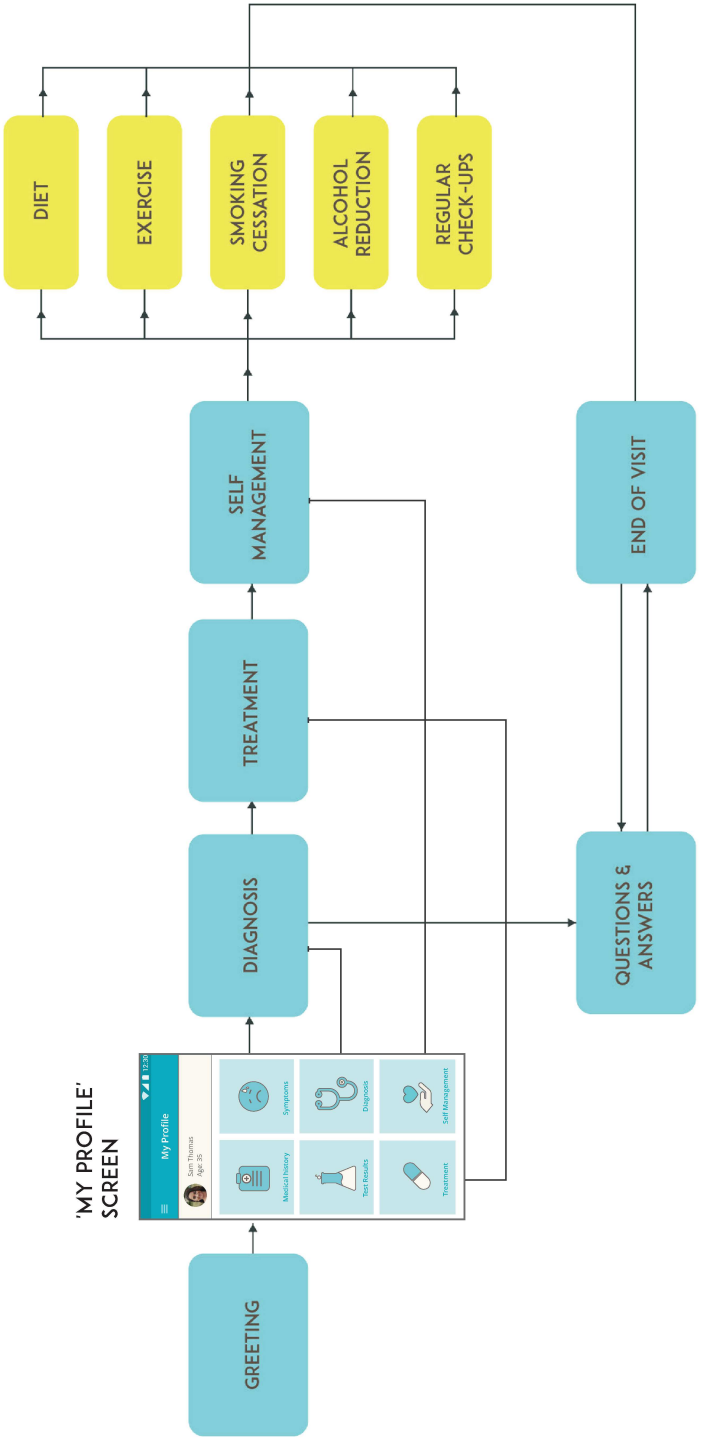
A typical treatment procedure of a diabetic patient follows two major steps:

1. Treatment using medication which involves taking prescribed doses of insulin.

2. Self management which is taking care of oneself. Self management usually includes taking care of the patient's diet and exercise, smoking and alcohol reduction, and regular blood check-ups.

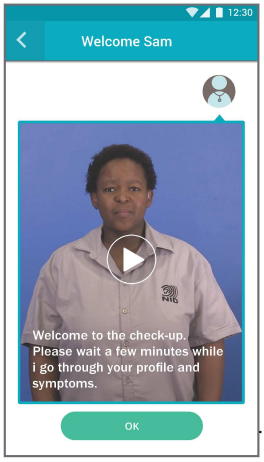
Flow A (page 45) is the upper level flow of the doctor-patient interaction and includes the two steps mentioned above. Flow B, C, D, E, F, G, I, J and K are smaller parts of the interaction. They explain briefly how treatment is provided during the doctor-patient communication. The parts illustrate several different moments in the interaction for example; when the patient is greeted, when the phone is shared between the doctor and patient, or when the patient asks questions to the doctor.

A. Upper level flow of SignSupport



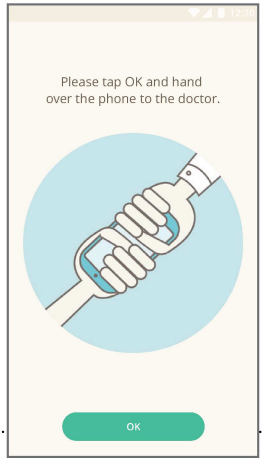
B. Passing the phone between the doctor and patient

Welcome video



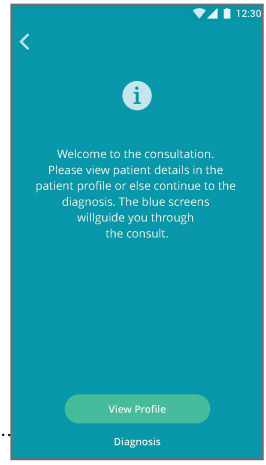
The videos are recorded in first person and the concept of chat-boxes is used to show that the doctor is saying something.

GIF phone handover



The concept of handing over the phone is introduced to the patient and the doctor in the start of the consult.

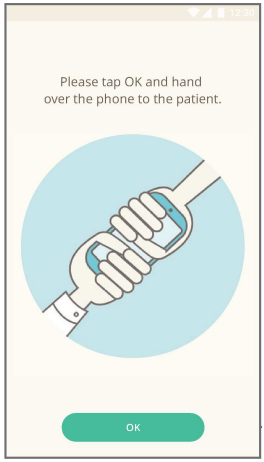
Patient profile



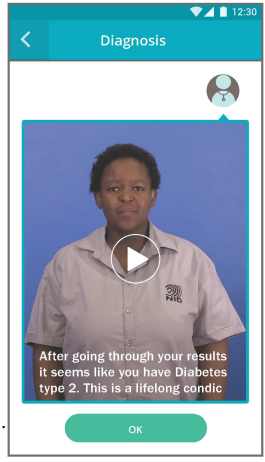
Example of content the doctor views (above) and content the patient views (below)

Everytime the phone needs to passed to the doctor or the patient, this GIF is seen with supporting text. The screen following this GIF is either text based or in SASL depending on whether the phone is being handed to the doctor or the patient respectively.

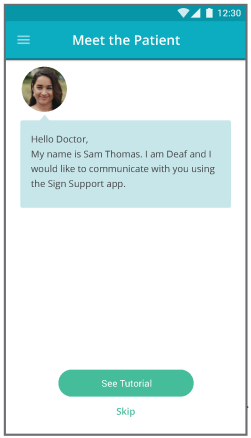
GIF phone handover



Diagnosis info

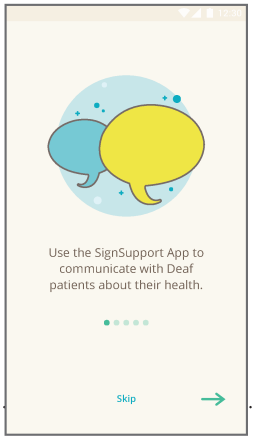


Meet patient

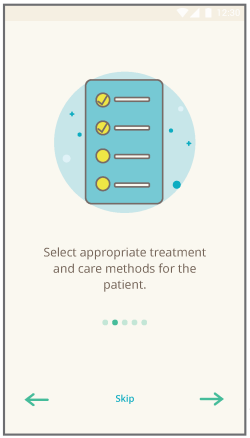


In the beginning of the consultation, the patient hands the phone over to the doctor. The doctor reads an automatically generated introduction about the patient and a tutorial about how to use the app.

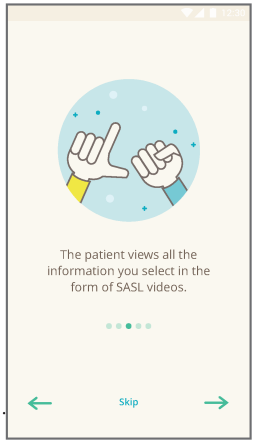
Tutorial 01



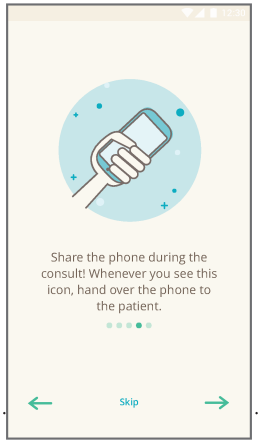
Tutorial 02



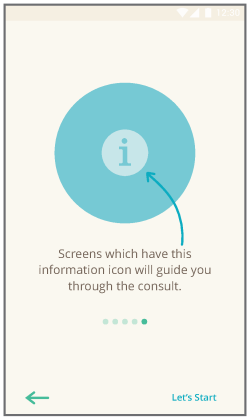
Tutorial 03



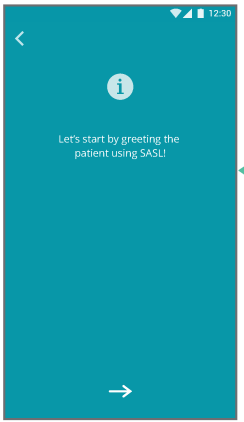
Tutorial 04



Tutorial 05

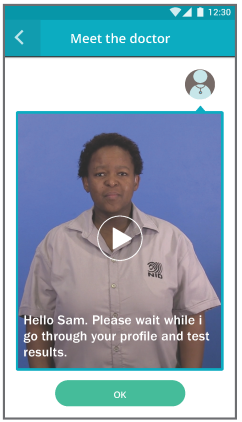


Greeting instructions



This is an instruction screen that appears from time to time throughout the app to give the doctor tips and instructions about how to proceed with the communication.

Doctor's introduction

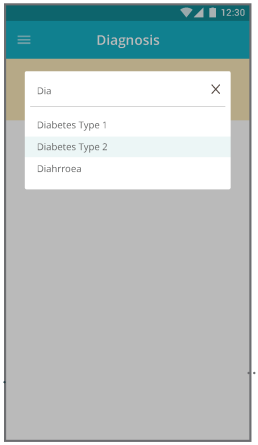


C. Introducing the doctor to the concept of the app.

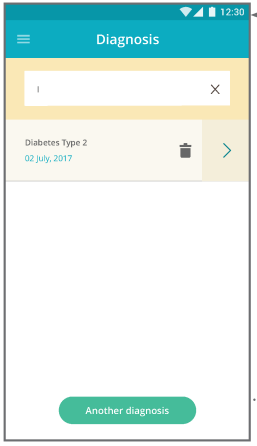
Treatment diagnosis

The doctor types the diagnosis after reading the symptoms report.

Diagnosis auto suggest

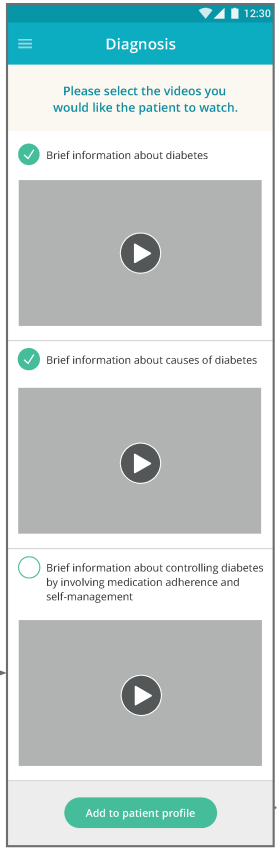


Diagnosis saved

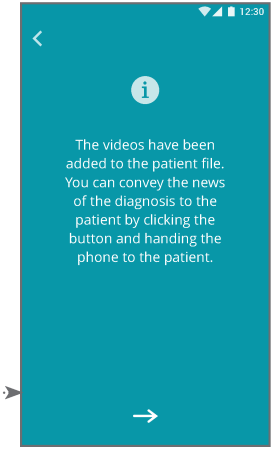


The disgnosis gets stored in the profile of the patient.

Diagnosis - Diabetes videos



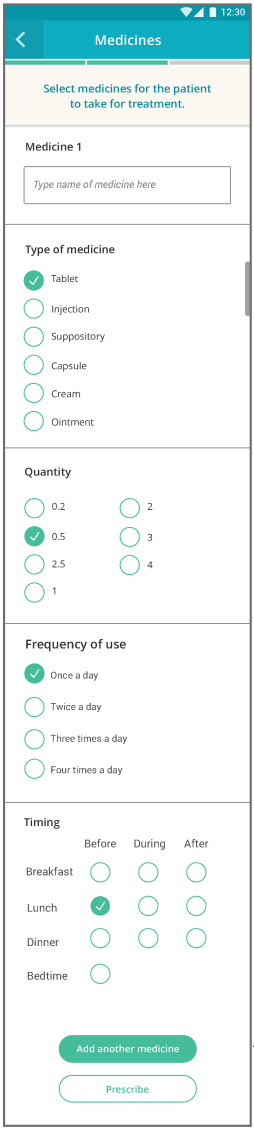
Diagnosis instructions for doctor



After selecting/typing the diagnosis, the doctor is directed to a list of SASL videos (related to the diagnosis) to select for the patient to view. These get stored in the patient profile as well.

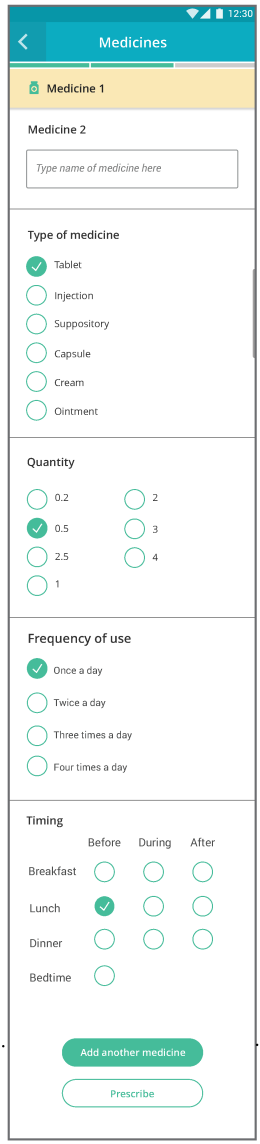
E. Doctor selecting medication for the patient

Select medicine

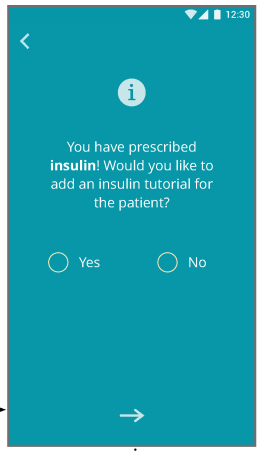


The doctor selects medicines and their dosage from this form.

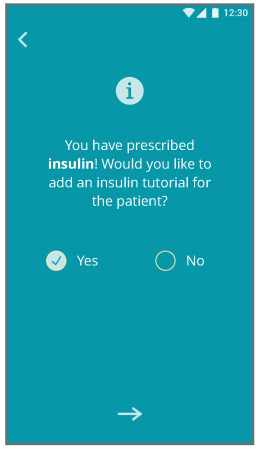
Add another medicine



Insulin video reminder

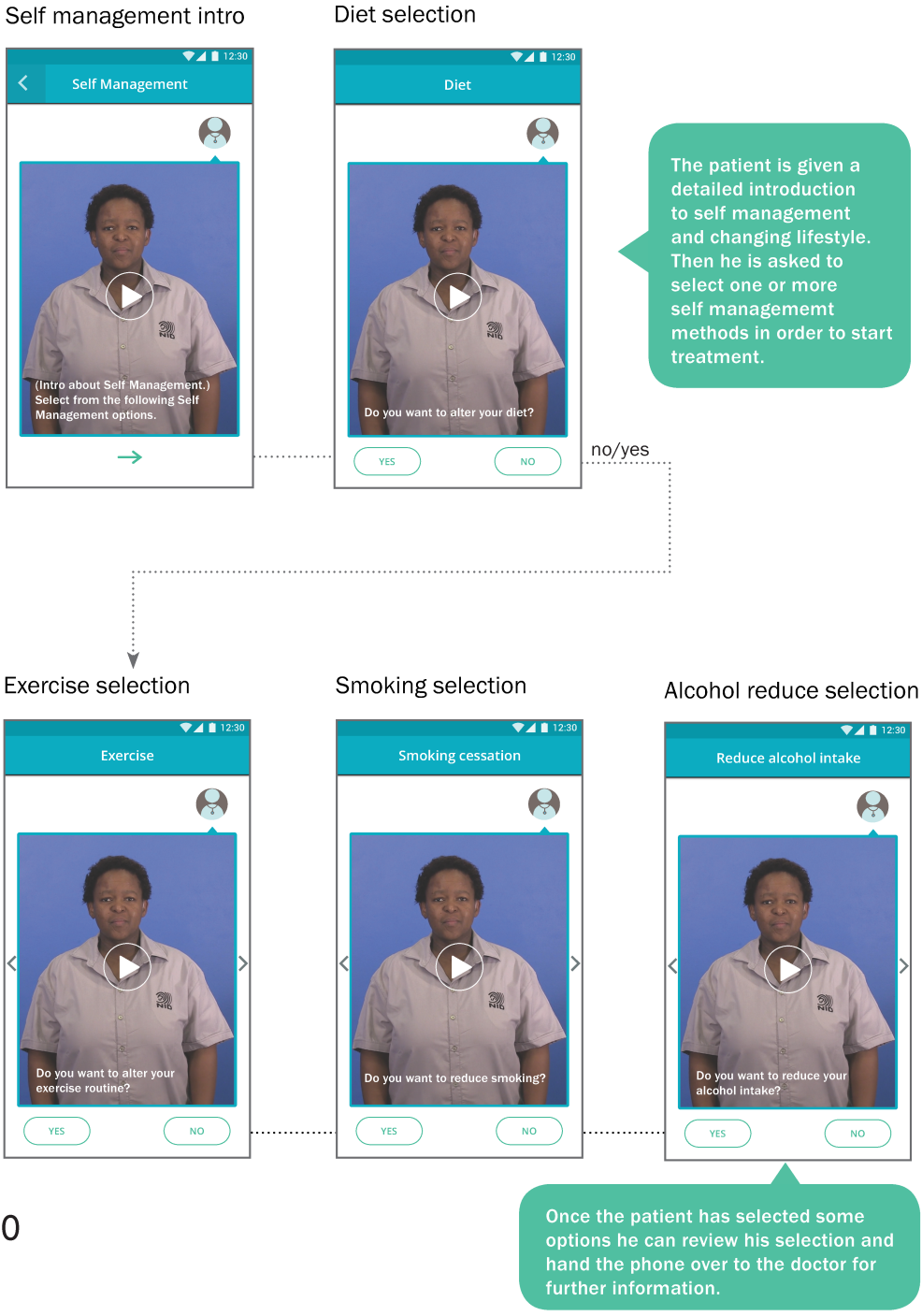


Insulin video reminder



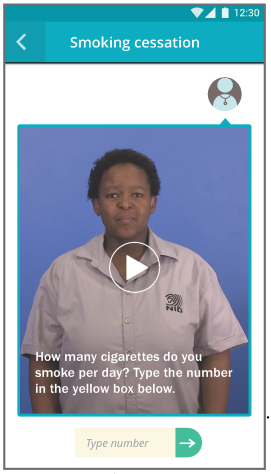
If the doctor prescribes insulin, he prompted to add an SASL video to the patient's profile about correct insulin usage.

F. Patient selects a few Self Management procedures to start treatment

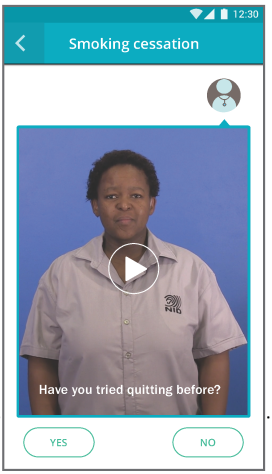


G. Informing the patient about smoking cessation

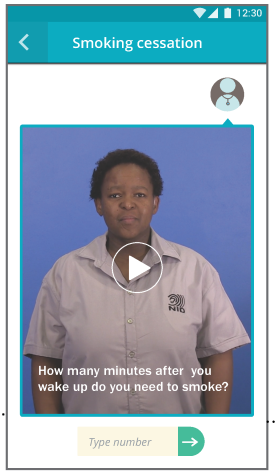
Number of cigarettes



Question about quitting

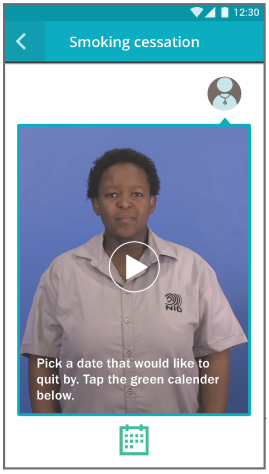


Smoke in the morning

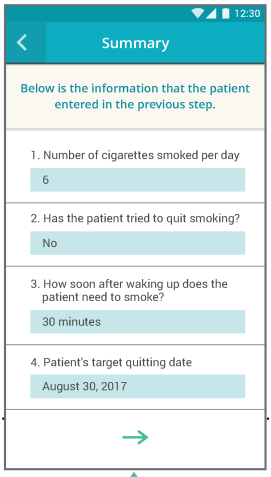


On some screens very specific instructions were given to test if the participants react differently to those compared to other screens (eg. page 52).

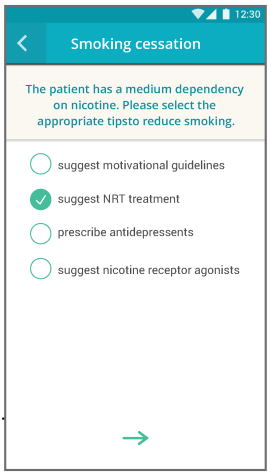
Set quitting date



Smoking summary



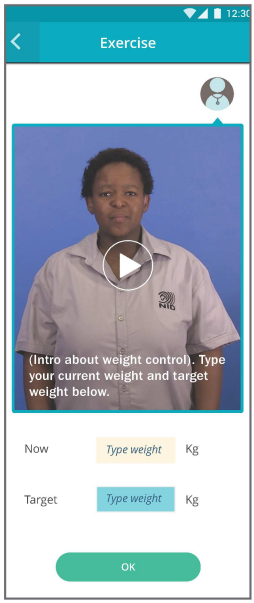
Tips on quitting



The doctor receives a summary of the selection and suggests treatment based on it.

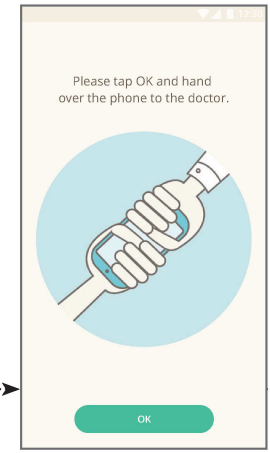
H. Changing the patient's exercise routine

Current/target weight



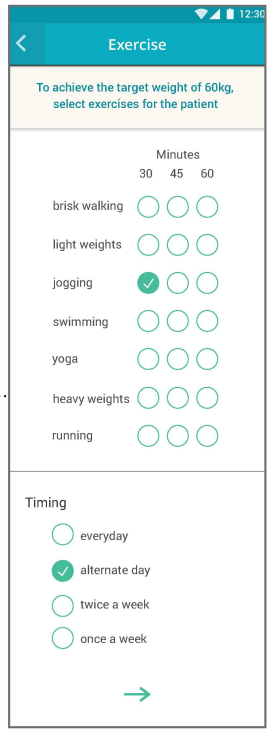
Here more type fields were added to the page to test how the user reacts to more information the page compared to Page 51.

GIF phone handover

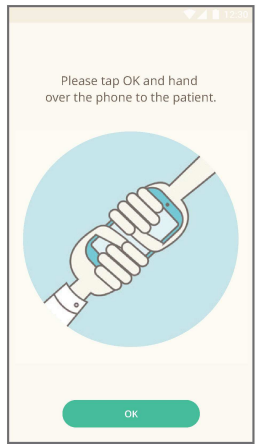


After the patient enters information about his weight, the phone is passed to the doctor who selects treatment based on the information entered.

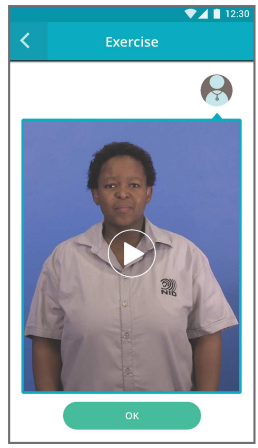
Doctor suggests exercises



GIF phone handover

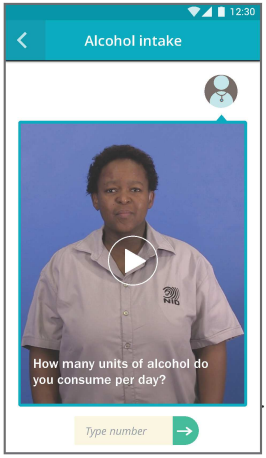


Doctor selects exercises



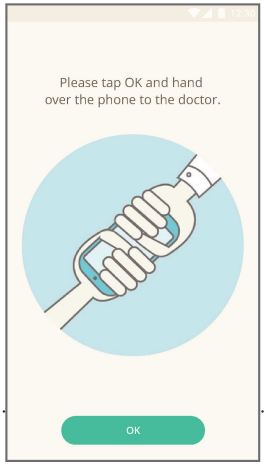
I. Controlling the patient's alcohol intake

Number of drinks

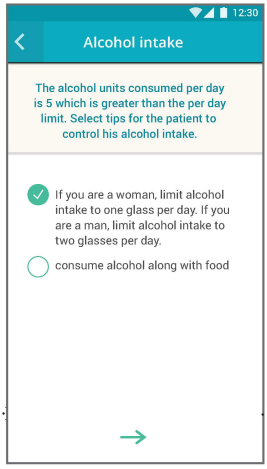


The patient is asked to enter information about his alcohol intake after which the doctor gives him advise on controlling alcohol intake.

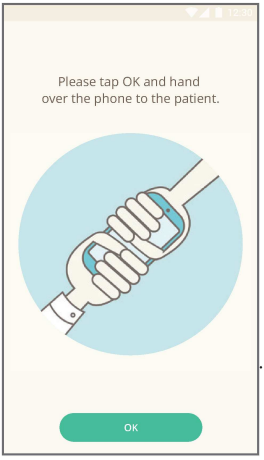
GIF phone handover



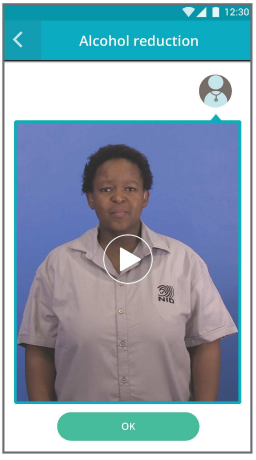
Doctor's suggestions



GIF phone handover

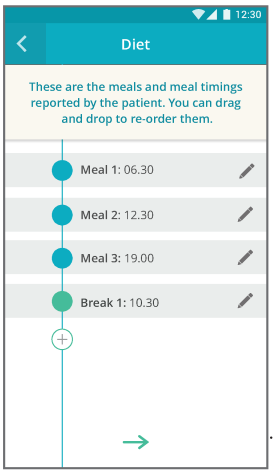


Doctor selects exercises

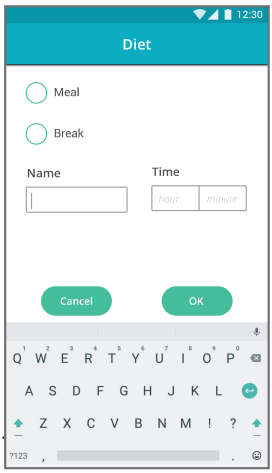


J. Changing the patient's diet and meal guidelines

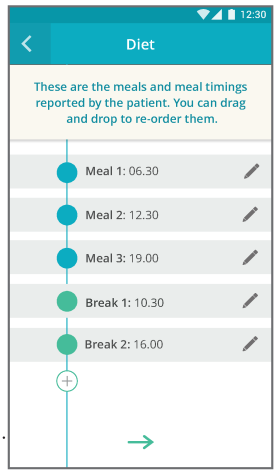
Meal timings



Adding meal timings

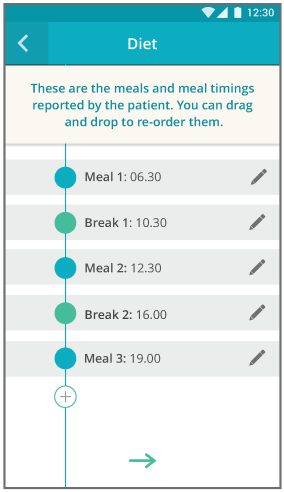


Suggested meal timings



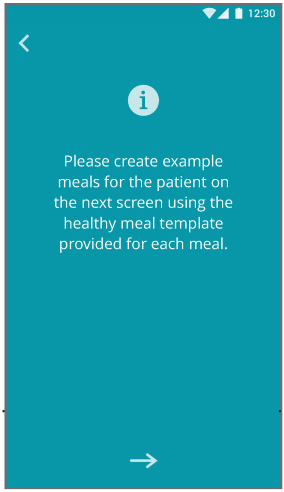
When giving information about diet, the doctor refers to the daily meal timings of the patient recorded by the nurse previously.

Rearrange timings

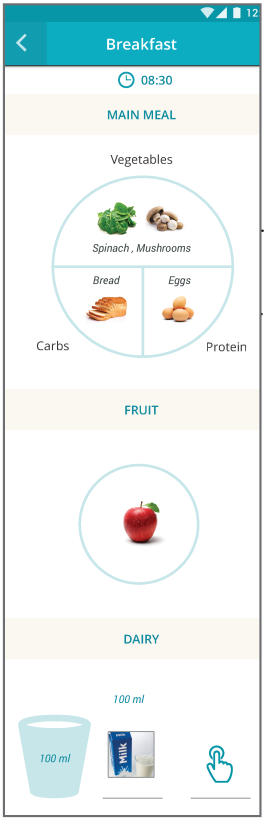


The doctor can add, remove, shuffle or suggest new meal timings for the patient.

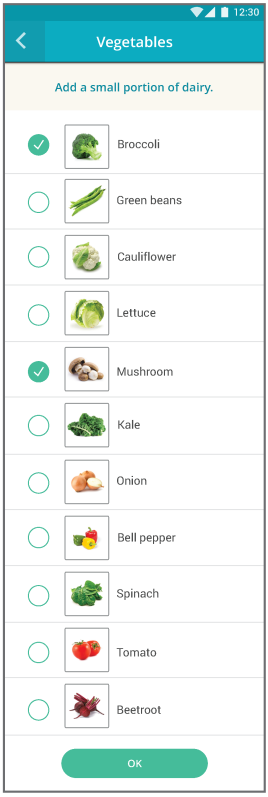
Instructions for doctor



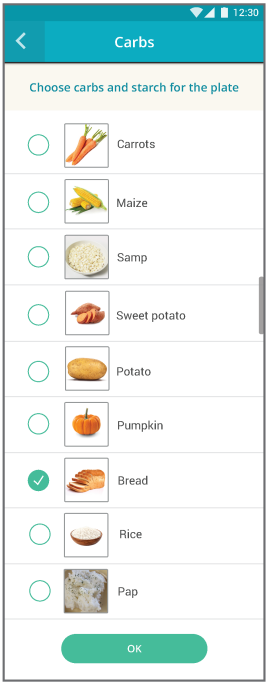
Example meal

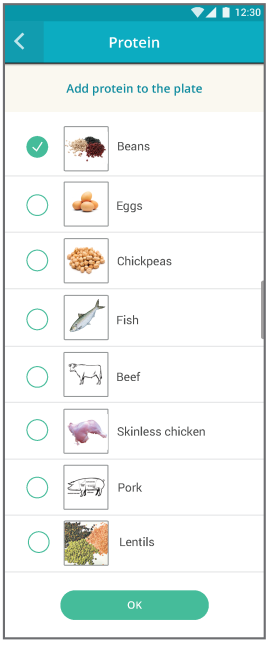


Healthy vegetable list



Carbs list



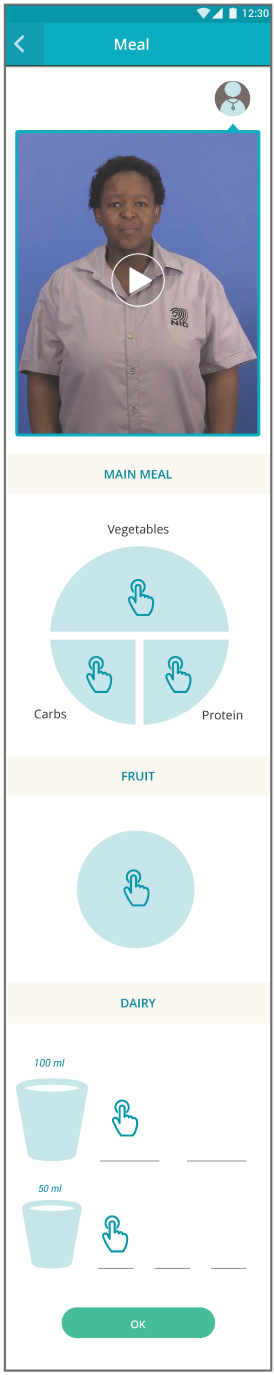


These meal timings are displayed visually for the patient along with food suggested by the doctor. The plate model and food proportions from the guide for diabetes treatment JEMDSA* is used.

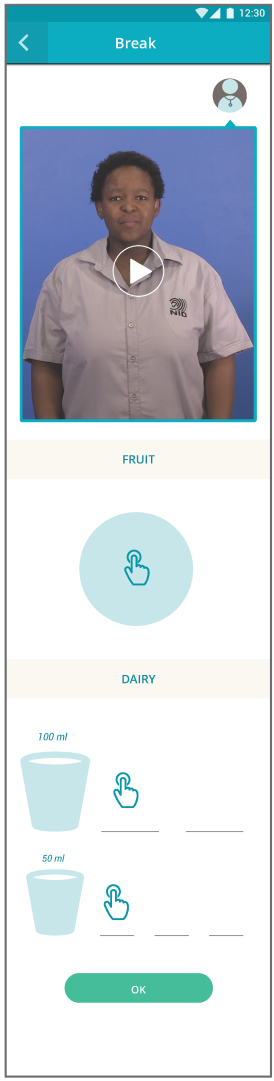
The doctor selects various food for the patient to create an example meal. Later the patient can create his own

* *"JEMDSA 2012 Volume 17 Number 1," Journal of Endocrinology, Metabolism and Diabetes of South Africa 17, no. 1 (2012).*

Main meal template



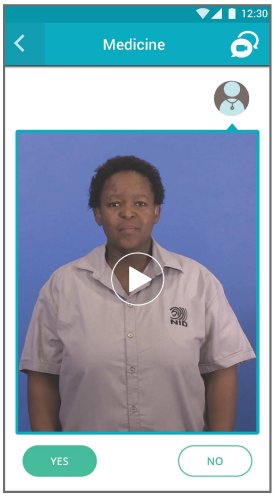
Small meal template



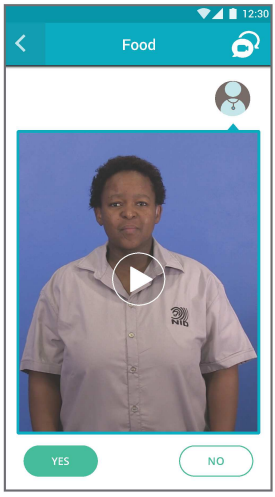
The patient can access the meal template in his profile to create meals for himself using the suggested food items. The SASL video instructs the patient on doing so.

K. Question and answers section

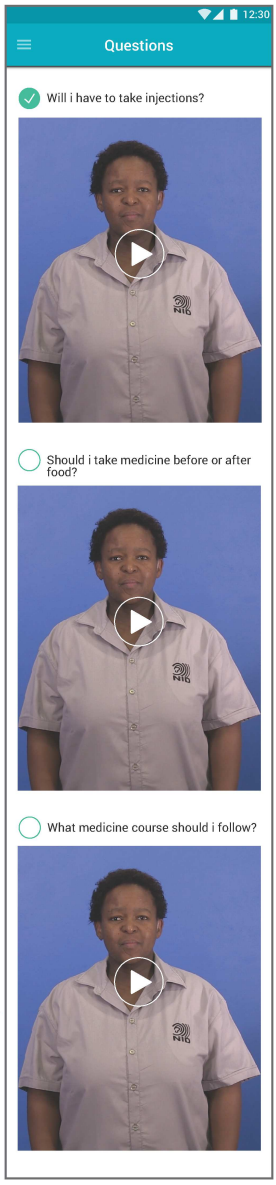
Q&A category 01



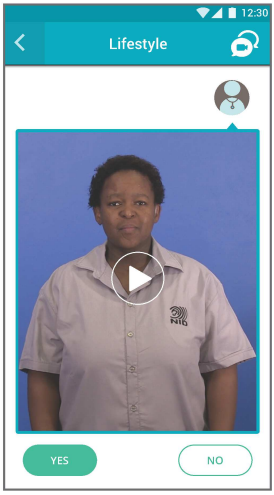
Q&A category 02



Questions about medicine



Q&A category 03



The patient asks questions by selecting a category and questions under the category. Incase the question isn't in the category, he can use the SASL video call service on the top right.

Each category has a number of questions gathered from user research. The image only shows the first three on the list.

7.2 Color research

The app uses two color palettes. The primary color palette consists of teal, blue and white. Blue is the dominant color whereas teal is used for buttons and interactive areas. Colors like yellow and brown are part of the app's secondary palette and used to highlight important information or draw attention. According to color psychology, a combination of colors affects a person's state of being.[37] Blue and green are colors that induce emotions like trust and tranquility and hence are often found in hospital settings. Orange is known to represent joyfulness[38] and is often used in combination with blue in medical websites. The color combination used in the design are of pastel shades to give a light and friendly feeling to the user.

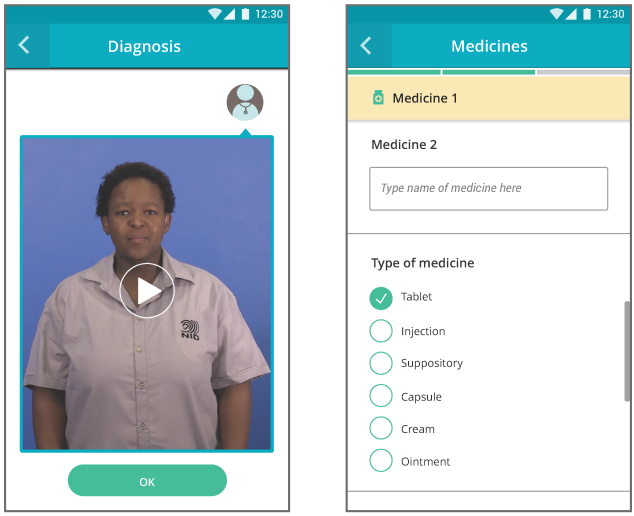


***Figure 13**: Use of primary and secondary color palettes.*

7.3 Iconography

The style choice for icons was bold and colorful yet playful. The idea was to represent the word depicted by the icon as closely as possible without cluttering the interface. The icons follow the color palette chosen for the app. The forms and color of icons that represent humans (Figure 14, icon for symptoms) are ambiguous so as to not arouse any negative emotions among users about gender or race.

37 *Angela Wright, The Color Affects System of Color Psychology (2009).*

38 *Ibid.*

In the section of the app where the user chooses food for his diet, the icons of food items were changed to real images of the food to give the user a clear picture of what he was choosing as well as to eliminate any confusion between foods that look similar (Figure 14).

7.4 Final designs

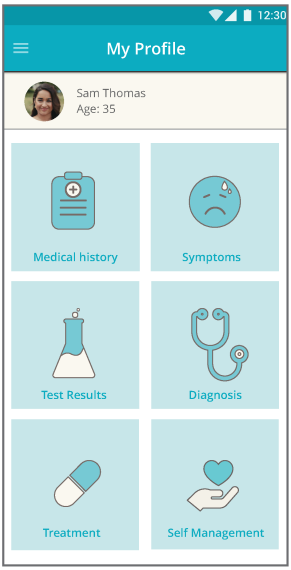


***Figure 14**: Icons in the user profile*

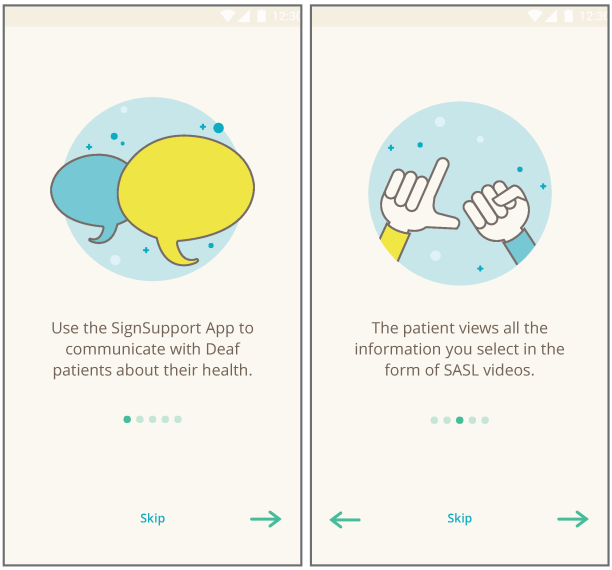


***Figure 15**: Icons for onboarding the doctor.*

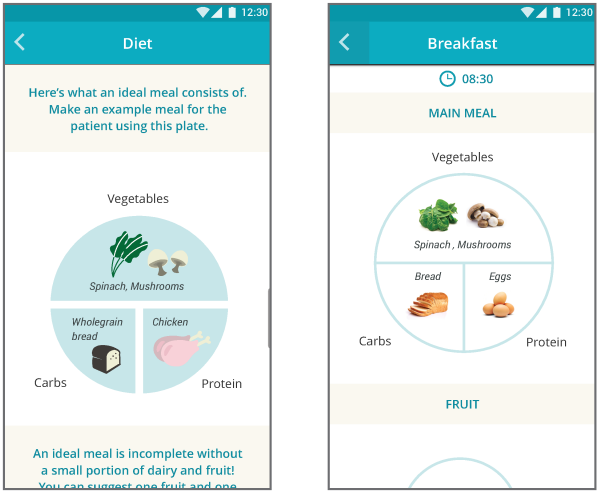


***Figure 16**: Illustrated icons (left) changed to real photographs (right)*

Based on the approach discussed in Chapter 6, interface designs were created. Below are examples of ways in which the Deaf user centered approach was applied to the designs.

Using SASL to communicate

Heavy text information or multiple choice pages are split into multiple screens and provided one by one to the user. Example; lists and questions are converted to SASL videos with a 'Yes' and 'No' button below each to enable users with functional literacy to understand information. A script for each screen was provided to the staff at the National Institute for the Deaf who recorded each video separately. Captions were added to each video to enable reading for those who do not sign.

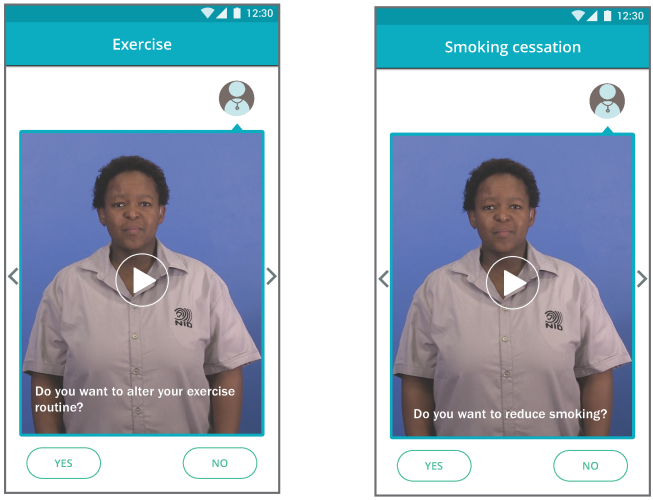
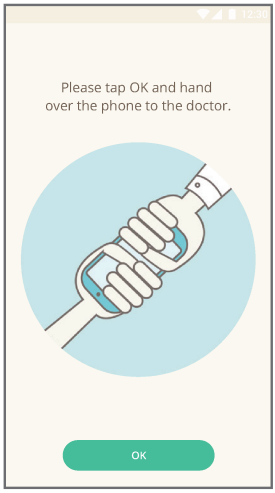


***Figure 17**: Using SASL videos instead of lists to help users pick out of multiple choices.*

SASL: Images instead of text

The screen used to prompt the user to handover the phone to the doctor was designed with an animated Gif (Figure 18) instead of text to convey the message visually. Similarly information about food and diet was also depicted visually (Figure 19).



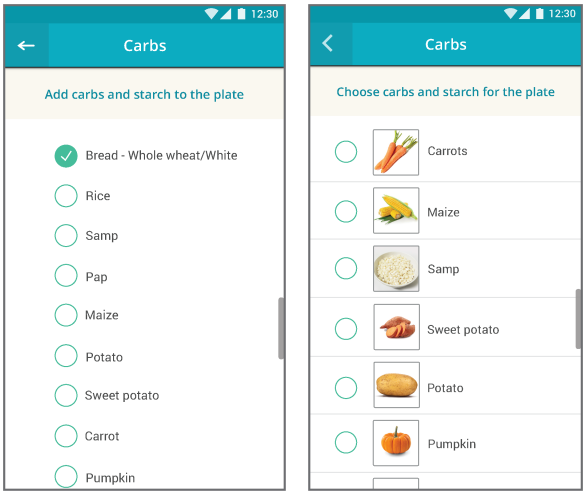


***Figure 18**: Animated gif to prompt the user to hand over the phone to the doctor.*

***Figure 19**: Draft 1 (left) and Draft 2 (right) of food selection page.*

On screens where the interface is a bit more complex (Figure 20), icons are used instead of text to indicate how the user can interact with it. This is done to enable the user to learn how to communicate using an alternative method of communication such as this mobile application. This is also known as a method of modeling information allowing the user to learn by giving indicators.

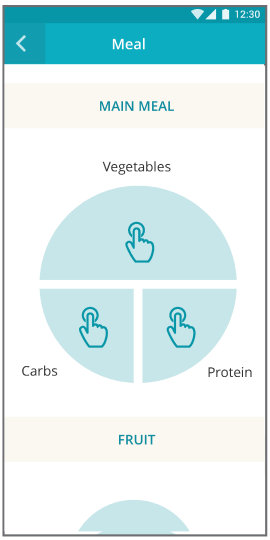


***Figure 20**: Use of icons instead of text directing the user to click on a particular part of the interface.*

Navigation

The app is used for communication and follows a linear flow. The procedure for treatment of Diabetes type 2 follows a number of steps in a specific order hence the flow of the app is fixed and the patient cannot be given the freedom to access the steps in a random order. Moreover, having a linear flow allows for a shorter path length, presenting information one after the other automatically instead of requiring the user to select from menus (Figure 17). Example of a simple linear upper level flow can be found on page 45.

Focal point

To ensure focus on the information being provided, the interface is designed to be minimal. The SASL video is the focus of the screen with a maximum of two calls to action around it. In some cases the video also gives instructions about where to click in order to proceed.

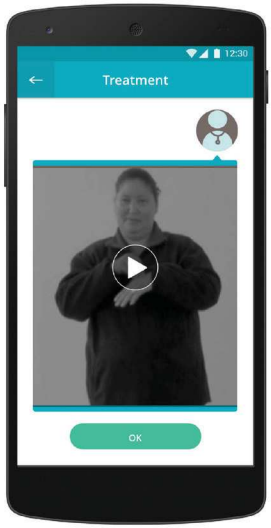


***Figure 21**: Interface (as seen on a mobile screen) with a focus on the SASL video.*

Content relevancy

The Q&A section of the app was designed after input from Deaf users in India and South Africa. The list of questions include the most common queries a patient would have about Diabetes type 2 treatment.

The text on the buttons such as ‘OK’, ‘Yes’ and ‘No’ is short and simple so that it can also be understood by Deaf users who do not have very advanced reading skills.

The app is designed differently for the doctor and the patient. The sections that the doctor has to access have more medical information in the form of text, whereas the sections for the patient contain more visuals and videos rather than text.

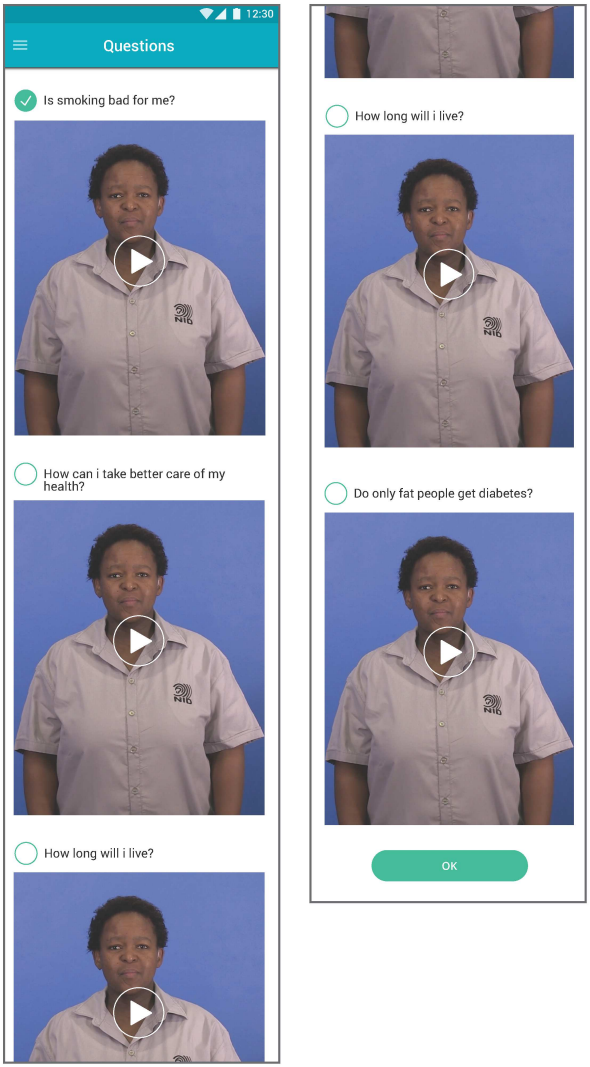


***Figure 22**: Questions about lifestyle in the QnA section.*

7.5 Prototyping

Prototyping is an essential part of user experience design, and is used to test the interaction quality and understandability of the product. The mobile application was prototyped using an online prototyping tool called *proto.io* and tested on an android phone. Five parts of the mobile application that were important in terms of achieving the user goal were tested.

The prototype was clickable and all important buttons on the page were interactive. Some pages which had multiple choice lists, were difficult to program on proto.io. On those pages, one or two of the multiple choice boxes were prototyped to show the behaviour. During the usability test, if the participant clicked on a certain part of the prototype which was not programmed, they were informed and instead the behaviour was explained to them using sign language. The prototype displayed medium to high fidelity in terms of interaction and visual design in order to get accurate feedback from the participants.

8

Usability testing and it's findings

8.1 Setup and Goal

Once the designs were ready, a usability test was carried out with a different set of research questions which were specifically formulated around the prototype.

RQ1: How can mobile application interfaces be designed differently to increase ease of communication and information understandability for Deaf users?

RQ2: How does a Deaf user experience digital information (text, videos, images) on a mobile application?

RQ3: How close is the experience of the app to feeling like a conversation with a human (in this case a doctor) instead of simply being a process of interacting with a phone.

The usability test was carried out at National Institute for the Deaf (NID), in Worcester, South Africa. A total of six people, three staff members and three students from NID participated in the usability test. Two out of six participants were advanced users and had prior knowledge of programing and user experience.

The usability test was carried out with 6 participants as testing with 5-6 participants can cover upto 85 percent of usability problems.[39]

39 Jakob Nielsen, "Usability Testing," Usability Engineering, (1993)

The test was conducted in a classroom on NID premises where the participant could sit and be comfortable while interacting with the prototype. The participants were first given the chance to interact with and get familiar with the prototype. The session was conducted with three people, the usability test conductor (myself), the participant and the SASL interpreter. A clickable prototype of the app was used on an android phone. This was done to provide the user with a user experience as similar as possible to interacting with their personal smartphone.

Goal of usability test

1. To test the understandability of the communication when the Deaf patient and the doctor interact using the mobile application.

2. To test the main components essential in order to achieve the user goal (Chapter 7.1). This was done by testing five parts of the doctor-patient interaction as described below.

1. Start of the consultation - In this section of the app the idea of passing the phone between the doctor and the patient were tested. This was done to see if the indication of handing the phone over to the doctor and back to the patient was understood by the user and if it allowed for easy communication between the two. Furthermore, in this section the information provided via SASL videos and the process of asking and answering questions during a consultation was tested.

2. Icons - On the user profile screen, the icons were tested to check if the user associated with them as intended.

3. Self Management - The user interaction while selecting one or more method of self management by swiping and/or clicking was observed.

4. Diet - Controlling one's diet constitutes a major part of Diabetes type 2 treatment. Information transfer about dietary requirements and restrictions using visual means and the user's understanding of this information was tested.

5. Smoking cessation - User interaction with the app interface while entering information step by step to get appropriate advice from the doctor was observed.

Participant selection

Three staff members and three students from NID were selected to participate in the usability test. This was done intentionally to have a mix of novice and expert users. Since the application would be used by deaf people from all backgrounds it was important to have a mix of participants to uncover more usability problems.[40] Two out of six participants were advanced users and had prior knowledge of programing and user experience as well as the project. Three were students who were viewing the prototype for the first time and did not have any design or programming knowledge.

***Figure 23**: Participant suggests using a photo of a sign instead of an icon.*

40 Jakob Nielsen, "Usability Testing," Usability Engineering, (1993)

8.2 Method

The usability test followed the steps listed below:

Step 1 - Introduction

First Appendix B was read out to the participant. This included my introduction, the brief of the usability test, and the rights and consent of the participant. Once the participant agreed to participate in the usability test, the rest of the procedure followed.

Step 2 - Personification

I explained the case to the participant through a storytelling technique using a persona (an imaginary character). The persona was a Deaf person named Sam (Appendix C). The story was that Sam wants to visit the doctor with certain symptoms such as fatigue, frequent urination and non-healing wounds. During the visit, he/she gets diagnosed by the doctor. The participants were asked to imagine that they are using the prototype for the first time to communicate with the doctor (who was played by me). They were also asked to put themselves in the shoes of this persona and use the app as if they were Sam using the app in a hospital setting.

Step 3 - Using the prototype

The participant was asked to do five short tasks, one after another. Each task lasted a maximum of 15 minutes. The tasks involved the usage of specific parts of the prototype. During this time the participant was asked about his/her choices and experience while completing each task. In some cases, the participant was asked to select one out of two design options and explain his/her preference.

Step 4 - Refreshment break

After the first three tasks, a short break was provided for the participant. The rest of the tasks resumed after the break.

Step 5 - Context and Q&A

Towards the end of the session, the participants were asked about their daily app usage and their feedback on the prototype they just used. Finally, the session ended with an opportunity for the participants to ask questions or give suggestions based on their experience during the usability test.

Step 6 - End of session

The participants were thanked for participating and the session was

closed. In order to record data from the session, notes were taken as well as each usability test was recorded on camera (Appendix C) with consent from the participants and later transcribed. Some notes from the transcript can be found in Appendix C.

***Figure 24**: Participant (right) using the prototype on an android phone while the interpreter (left) helps her communicate.*

8.3 Results

Below is the summary of results from the usability test. Detailed results can be found in Appendix D.

1. All participants found the animated Gif of handing the phone over easy to understand, however one participant raised a concern about not wanting to share the phone during the consult.

2. The Q&A section of the app was confusing. Two participants did not realize that the questions in the section were for the doctor, instead they felt that they had to answer the questions themselves. Two participants also commented on the method of selecting the

questions. They found it easier to tap on the video directly rather than selecting the check-box.

3. All participants mentioned that the SASL videos were very clear and made it easy to understand information. Even though the idea of communication with the doctor did not come across through the speech bubble graphics in the design, they felt that getting accurate information through videos was better than trying to communicate with the doctor directly.

4. In the section about diet, having an image of the food alongside the name of the food made it easier to understand and pick food items. Four out of six participants really liked the use of images and the food selection screen. However the order in which information was presented made it difficult for them to get a sense of how to use the food selection feature. It was only when they reached the end of the section that the participants realized that they could alter the meals suggested by the doctor according to their tastes and that the suggestions were not hard and fast rules.

5. Two participants suggested that the videos can be even bigger and be the main focus of the screen instead of having other elements on the screen.

6. Two out of six icons on the profile page were unclear and the participants suggested signs that can be used to represent them instead of the current icons.

7. The participants found it easier to proceed with using the app when there were clear interaction instructions given within the SASL video itself.

The feedback from the usability test uncovered some problems the participants faced as well as features that worked well. The feedback will be incorporated into the re-design process at a later stage and is not part of the current scope of the thesis.

9

Conclusion

9.1 Reflection

The project was a complete experience of conceptualizing, designing, prototyping and testing. Although the project was a success, i gained a lot of insight on the advantages and drawbacks of my own working process. There are a few things i would do differently if i were to repeat the project hence the list below summarizes some of the victories and areas where there is scope for improvement.

9.1.1 Victories

Collaboration with a university - Collaborating with TU Delft greatly benefited me in terms of professional guidance, finances, resources and connections in the field. Supported by a team with years of knowledge about the subject gave me the confidence to carry out my research in South Africa independently. Since some part of the research was previously done, it gave me a lead on the subject and prevented me from repeating mistakes, allowing me to learn from them instead.

Spending time with the Deaf community - I spent a week with the staff and students at the National Institute for the Deaf in SA and two days with some members of the Deaf community in India. During this period i got a deeper understanding of the target groups background, environment and communication needs. Being the only person at NID who was unable to sign, i always needed an interpreter to communicate. Without one, no one in the institute (other than some staff) was able to understand me. This role reversal helped me experience the day to day difficulty of the Deaf first hand.

Usability testing in South Africa - Being able to test my designs, not just with any Deaf community but the exact one that i was designing for gave me a lot of insights that would be impossible to gain without visiting South Africa. I also received various reactions from the participants of the usability test which strengthened my reasons for certain design choices and weakened my motivation for others. All in all testing in South Africa was a really fulfilling experience.

9.1.2 Scope for improvement

Software choices - I used Adobe XD for designing the wireframes and screens and proto.io for prototyping the app. Halfway through my project i found that using Sketch (for wireframing) in combination to Flinto (for prototyping) would have been a much better choice. Adobe XD was still in the beta phase when i started using it and so a number of features were either not released or were likely to change at any time. Most importantly, there was no quick way of sharing files between my designing and prototyping software (proto.io) which increased the time spent saving and uploading files each time i wanted to test an interaction.

Proto.io is one of the few prototyping softwares that allows one to prototype freely with videos. Since SignSupport mainly uses SASL videos in the app, this was definitely an important feature to consider while choosing the right software. Although proto.io allows complex prototyping, the software's interface is not very user friendly and significantly increases working time as compared to some others.

Time allocation and management - I spent a lot of time on desk research which in hindsight was not necessary as the research team i was working with already had significant findings from their research. I spent the first 5 months of my thesis on trying to carry out desk research which ultimately caused time management problems during the other phases (designing and prototyping) of my project. Over the course of my project i also realized that it was wiser to set many small achievable goals as opposed to take on too much with a very large goal.

9.2 Future SignSupport

SignSupport is an information transfer platform and this thesis can be seen as a starting point of future implementations of the service in many other fields. Communication is important in every aspect

of life, thus a service like SignSupport can be useful in the field of education, travel, public services as much as healthcare. Once implemented in the field of healthcare as described in the thesis, the research, advantages and drawbacks will be recorded for further use.

During the design phase and usability test a couple of other ideas emerged which could be added to future implementations of the concept. Two of them are described further below.

9.2.1 Online Health network

One of the concepts was to build a health network account which a Deaf person can log into using their personal identity number. The account will log information about all the user's hospital visits and link him/her to relevant health information videos in sign language.

Advantages

- A private account will ensure more patient privacy than a mobile phone. Only doctors will be able to login to see the patient's medical history.
- The patient can have access to his/her health information anywhere as long as he/she is connected to the Internet.

Disadvantages

- Deaf people without a personal identity number will not be able to access the network.
- Implementing the use of something like this across multiple hospitals will be difficult.

9.2.2 Interactive screens in healthcare spaces

Another concept was to install interactive screens in health care facilities in waiting areas specially for Deaf patients. Using these screens the patient can access sign language videos about various health conditions.

Advantages

- The patients can learn about their condition and increase their knowledge of healthcare while waiting to see the doctor.

- Deaf patients feel more included in a hospital environment instead of feeling uncomfortable.

Disadvantages

- If there are one or two screens for all, not everyone will be able to use it.
- Not many people are used to interacting with a large screen in a public space hence there will some effort spent learning.
- Health information is personal and users might not be comfortable viewing information about their condition in a public space.
- The patient will not have access to the health information at home.

My thesis is a step towards emphasizing the importance of accessibility in the field of user experience design. My project paves way for further research and design opportunities in the field of accessibility, especially designing for a Deaf user. The insights from the project can be used for systems other than the mobile phone and in areas other than medicine. The project is currently undergoing changes based on the feedback from the usability test. Changes and suggestions are being incorporated into the new designs of the app. The project is currently being continued by Prangnat Chininthorn of Technical University of Delft and efforts are underway to provide a complete interaction design to developers for the final development of the mobile application. As of now the aim is to incorporate the feedback from the usability test and develop the latest designs for SignSupport by July 2018.

B

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A

Appendix

Appendix A

DAY 1

Setup
4 participants, 1 translator, 1 trainee assisting the translator, Workshop Facilitator and 1 person taking notes are seated in a circle.

For the transcription the following symbols will be used:
Participant 1-4, ie P1, P2, P3, P4 denotes all the participants. Names of the participants are anonymous to secure their identity and privacy.
WF: workshop facilitator
N: person taking notes
Int: denotes the Sign language interpreter
(...) denotes a pause in the speech.

Introduction
WF: Hello, my name is Saudamini (...) I study in Europe (...) I am here today because I am working on a project. (Opens laptop to screen with photos of sign support) I am designing a mobile application that will help you communicate with doctors in hospitals (...) We have already finished half the project, but to make it even better I need your help. (...)
These are my two friends who will help me take notes.
Is everyone here okay to participate in my research? If so, please raise your hands.

(All participants raise their hands)

WF: Today I will be asking you some questions and telling you about what all activities we will do today and tomorrow so that I can make this project better.

(passes the laptop around)
This is a mobile application using which deaf people can communicate with doctors.

Exercise 1: Warm up
Why don't we start by introducing everyone? Can you all tell me a little bit about yourself and what you do here? Why don't we start from here? (Points to the right corner of the semi circle)
P1: My name is B****. I am a fitter.
P2: M*****, also fitter
Int: They are all studying to be a fitter.
WF: What is a fitter?
Int: They do mechanic and electric fittings.
P3: A****
P4: R********
So (...) you must have all been to a hospital at some point?

All participants nodded their heads
Int: Yes they all have

WF: Can you all tell me about one time that you went to the hospital and how you remember it? Why don't you start (pointing to P1)

P1: I went to the hospital because had fever.
WF: Who did you go with? Did you go alone?
P1: I went with my father.
WF: What was it like?
P1: My father can sign so he spoke to the doctor.
WF: Do you like going to the hospital?
P1: No I do not like it because no one uses sign language.
Int: Communication is a problem, he is saying.

WF: What about you? (Pointing to P2)
P2: I went to hospital because of breathing problems
WF: Does he mean Asthma?
Int: Ya, ya
WF: Who did you go with?
P2: I went with my mother. She translated everything.

WF: Do you like going to the hospital?
P2: Yes, I like it (smiled and nodded his head)

P3: I went to hospital because I got sick because of air pollution. I went with my mother.
WF: What do you feel about going to the hospital? Do you like it?
Int: The main issue that they are all saying is lack of communication with the doctor, but he got help from his mother for translation.

P4: I also went to the hospital for fever.
WF: Do you always go alone?
P4: One time I went alone, ya
WF: How was your experience?
P4: I communicated with the nurse by writing.
WF: Did they understand you?
P4: Yes, they understood.
WF: How do you book an appointment at the hospital?
P3: My mother calls the hospital.
Int: They go with their father of mother.

Exercise 2: Introduction to Diabetes
WF: Okay, now do any of you have diabetes?
Int: sugar, sugar (The interpreter signed what it means to have excess sugar in your bloodstream)
(The participants seem to have understood what diabetes is...)
Int: No they don't
WF: do your family members have diabetes?
Int: No they don't
WF: Then I will tell you briefly what diabetes is (...) You all know that we all need to eat food in order to be strong (...) Our body needs the sugar from the food we eat in order to be strong (...) You know when you don't eat food, you don't have much energy and your body gets tired easily (...) Now imagine that you are eating well everyday (...) still you feel very tired all the time (...) This is what happens when you have diabetes (...) This is because the body does not use the right amount of sugar in your blood and that means there is too much sugar in the blood making you sick.

WF: In our project we are making this application especially for people who have diabetes (...)
And we are making this application to help deaf people who have diabetes visit

the doctor alone without any help.
End of Day:
WF: Today's session is almost over, but before we finish I want to ask you, how many of you like drawing?
(Two participants raise their hands)
WF: Tomorrow we will do some more exercises that will require you to draw or write about your experiences. When you go home today I want you to do two things. First I want you to think about your experience at the hospital and what was good or bad about it because tomorrow we will be drawing it.

Second, imagine that this application we are designing is a magic wish box. Anything you ask of it can come true. Now imagine that every time you go to the hospital you have this magic box and you can change whatever you like about your experience. Then come back to the workshop tomorrow and we can talk some more.

Thank you for your time today.
(everybody signed Thank you)

DAY 2

Setup
All the participants seated in two rows on chairs with foldable tables attached to them. The interpreter sat in from of them, facing them. The workshop facilitator and person taking notes stood around a table. A laptop placed on the table facing the participants.

WF: Hello again, for those of you who don't know me, I am Saudamini Tambay…
Int: Don't worry I will introduce it.
WF: Can you also please tell them about the project like I did yesterday?
Int: ya, ya
(explains the introduction from Day 1 in Sign language)

So to help you understand what I am working on better I will show you a video. This is a video of the mobile application already designed.

Exercise 1: Drawing their experience at the hospital
After the video sheets of paper and pens were handed out to the participants.
WF: Today we will draw an experience at the hospital.
(The participants drew for 15 minutes)

Int: Should I ask them to stop drawing?
WF: We can start with the one who is done and the rest can finish while I talk to him.
P3 is the first to finish
WF: Can you explain your drawing?
Int: He has drawn a scenery, house and road and an ambulance. An accident has happened and the ambulance has come to take the person. If an accident happens, if I cannot sign then no one will help, he says.
WF: Okay, lovely

WF: Can you explain your drawing? (Points to P1)
P1: It is a hospital shop, where we buy medicines. When I go to buy medicines with my mother there should be someone at the hospital shop to help me communicate. No one knows sign language.
Int: (further explanation translated by the interpreter) If doctor suggests some medicines you have to go to the medical shop. So if he goes alone he won't understand. If the doctor come with him and helps him that will be helpful.

P2: This is a hospital scene with a doctor and a me. The doctor does not sign so my mother has to help.

Int: Pointing to P4, the others are just drawing the scenery. They are not understanding what you asked (laughs)

Exercise 2: Favorite mobile applications
WF: okay great! Now tell me, you all use mobile phones?
And you all use mobile applications?
(Everyone nods collectively)
Can each one of you tell me which application you like using a lot and why you like it?
P3: Video chat with friends
WF: Why?
P3: I can see if my friend is sad or angry or happy.
Anyone else?
P1: Facebook. I like talking to friends.
A few participants: Whatsapp
WF: Why do you like Whatsapp?
P2: I can send pictures and emotions to friends.
WF: And what about you? Do you use anything you like?
P4: Video chat with friends. I can see if they are eating or what they are doing.
Great, let's take a short 10-minute break. I have some refreshments for

everyone and then we'll play a game.
10 minutes later

Exercise 3: Role playing
WF: Okay, so now we'll play a game... Imagine that this girl here (pointing to the person taking notes) is a doctor... And you are all sitting in a waiting room at a hospital. You are accompanied by your hearing sister (played by the interpreter)
You all have the following three symptoms:
You pee a lot
You get tired very easily
Your wounds don't heal fast

One by one, each of you can go to the doctor and tell her about your symptoms. The doctor then informs you that you have diabetes.
P1: Can I eat sweets, cakes?
What medicines to have?
Doctor: Anything else?
When should i eat the medicines? How many times?
Doctor: Okay thank you.

P2: I will eat healthy so I will not have diabetes.
Doctor: But can you imagine that you already have it? Let's assume you do?
Int: (explains the scenarios again to P2)
P2: Will I have to take injections? I don't like taking injections.
Can I get all pills? I would like to have only tablets, no injections.
If I exercise regularly will I feel better?
Doctor: Okay

P3: Will I be able to I eat chicken and eggs?
Does meat have sugar?
Doctor: Do you like eating meat a lot?
P3: I like eating at restaurants. Is it better to eat home cooked food?
Doctor: Thank you for your questions.

P4: I will eat only healthy food. That way I will not have diabetes. I will eat fruits and vegetable, won't eat chocolate and cakes.
Doctor: Let's imagine that you already have diabetes. Then what is is that you would want to know?
P4: One should not smoke and drink, that way they will not be sick.
Doctor: Okay, thank you.

WF: This was the last part of our workshop... Thank you all so much for participating.

Appendix B

The information below is bulleted in English because a professional SASL interpreter will interpret it into SASL for Deaf participants. All Deaf participants are fluent in SASL, and the interpreter is fluent in both SASL and English.

1. Self-introduction
Hi. My name is Saudamini Tambay. I do not have a signed name yet.
I am a student from design faculty. I am studying at Aalto University in Finland.
I am also collaborating my research with Prang, whom you might have met.
Prang is studying at Delft University of Technology in the Netherlands and University of Western Cape in South Africa. She does research on a mobile app called, "SignSupport." And her case study is on diabetes care..
I am here today because I would like to ask Deaf people to test the design of a mobile app I have created.

2 What is this research project about?
Do you remember the last time you visited a hospital? How was your experience while communicating with the doctors?-- If you went to the hospital without the an interpreter, the consultation might have been confusing to you. Therefore, with my interest to solve the problem, I have designed the interface of a app to help Deaf patients interact with doctors and other healthcare personnel. This is so that Deaf people can have access to health information from doctors, when there is no assistance from a SASL interpreter.
The research team and I respect Deaf people's opinion about making the app design better and also knowing which solutions best suit their needs. So I am inviting Deaf people to test out my designs and give me feedback and suggestions in making the designs better.
Our focus is on health information about diabetes.
In the future, we aim to have an app which can help give accurate health information for Deaf people.

3. What do we want to achieve?
We would like to make it easier for Deaf people to understand health information during a consultation with a doctor or a health worker in the absence of the signed language interpreter.
The case study focuses on information about diabetes.
I will use a mobile phone as a communication bridging app and a health knowledge tool, based on Prang's previous research.

The app can be used in 2 scenarios:
1) A Deaf patient uses the app to communicate with a doctor during consultation.
2) A Deaf person uses the app to search for health information about diabetes. The app will deliver health information about diabetes to a Deaf user in SASL.

4. What will we do?
Today we have invited you as a representative a the Deaf community to participate in this small usability test.
I will request you to use my design on a touch screen laptop. That means you will get to watch some videos and tap some buttons. Then you will answer a few questions that will help me understand about your feelings and thoughts while using the design.
A SASL interpreter is going to assist with the communication during the usability test.
The session will take around 1 hour and 30 minutes, including a short break with refreshment.
A video camera will be recording our discussion throughout this session for further analysis by the research team.

5. What do we expect of you?
I would like you to observe how you use the app.
You will give me feedback about whether the information is understandable.
Or otherwise, you will tell me of anything that is unclear.
You can also give me ideas of how to design the unclear part differently.

6. Benefits
This app is not meant to replace a SASL interpreter. It is for the use when Deaf people who cannot find or afford a SASL interpreter, but need to get health information.
This app will give information in SASL to enhance Deaf people's understanding about diagnostics and importance of the treatments and medications of diabetes. In the future this app is planned to provide more health information than only diabetes.

7. Risks and difficulties
There is no risk or difficulties in this group interview.
There is no question in the session that will require you to reveal your personal medical history or disease.
8. Withdrawal and confidentiality

All videos and photographs recorded during the research session will be kept confidential and will be stored on a computer with a password that is known only the responsible researcher. Your identity will not be disclosed in public unless we receive permission from you.
Please be informed that you have the right to withdraw from any research session by informing me. As soon as you withdraw from the session, all material with your information will be destroyed.

9. Dissemination of the study results
The results of this study will be disseminated when the study is completed in the form of papers and presentations at various conferences and journals. Data may be used toward the awarding of higher degrees to the co-researchers involved in the study.
Deaf participants will be kept informed via several presentations at their Deaf community at strategic times of the project life.
For more information, please do not hesitate to contact:
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10. Request of informed consent from Deaf participants
Do you have any questions about this project?
Please note that the signed language interpreter will be keep our discussion during the usability test confidential and not repeated. If you agree that you fully understand this project and what you will be doing during the session, please raise your hand to indicate that you would like to participate in this project.

Appendix C

Task 1: Use the app to test the introduction flow. In this section the doctor greets the patient, diagnoses him with diabetes and then selects a few videos for the patient to watch. After the patient watches the videos he can ask the doctor any further questions he might have by selecting from a list of questions.

Task 2: The participant is shown the following screen and asked to guess what all the icons stand for.

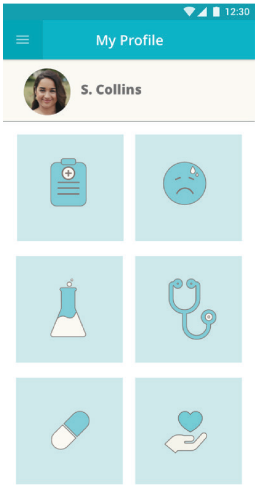


***Figure 25**: Myprofile screen without text labels for each of the six sections.*

Task 3: Use the app to test the Self Management choices. The participant is shown a number of self management options such as diet, exercise, alcohol and smoking cessation one after the other to choose from. Here the idea was also to note which self management methods the participant chooses and how he/she interacts with the screens

Task 4: Use the app to test the Diet flow under the Self Management section. Here the user is given suggestions about what time of day to eat his meals and what kind of food to eat in each meal. The user can choose food items for himself by selecting from a list available to him. The aim of testing this section was to observe the interaction of the participant with the food selection form and test his/her understandability of it.

Task 5: Use the app to test the screen where the user is asked to enter his current and target weight in two different colored boxes. This was done to see if the user understands the information laid on a screen. As a second part of this test the flow was broken into more parts to see which design the participant prefers more.

Below is how each participant in the user test is referred to:

Participant 1: P1
Participant 2: P2
Participant 3: P3
Participant 4: P4
Participant 5: P5
Participant 6: P6
Usability test facilitator: F

Participant responses to tasks:

Below a few of the important responses to/during tasks have been summarized.

Task 1

Was the information in the videos understandable?
P1: Yes, but the subtitles change too fast. A deaf person needs some time to read the text. There are 2 lines, perhaps the first line can go a bit faster and the second can go a bit slower.
You must use a neutral colour for the background of the video. It mustn't be too dark or too bright. The white background in one of the videos is distracting. We usually use blue, blue is a good colour for the background. Also all the backgrounds can be consistent so that they are not distracting.
P2: The subtitle sentences are too long and they go too fast. They need to be slower because we need time to read
P3: The videos is very small. It can be bigger, almost the full screen. It will also be good if the video can be flipped to landscape mode to make it even bigger. Because now i'm looking at the person who's signing and the subtitles also. So i have to leave the person and look at the subtitles. The person signing should appear full.

How did the participants perceive the passing of the phone animation?
P1: I understand it. It means pass the phone to the doctor
P2: I understand it. I think i have to pass the phone..to the doctor. Though a

patient might not be comfortable giving the doctor his phone.
P3: Here you can have a small icon of the doctor. I understand that i am supposed to pass the phone to the doctor but the visual can be clearer. Maybe on the side of the doctor's hand you can have a small indicator that it's the doctor (like an image). That exchange should be shown.
P4: I think i have to pass the phone to the doctor

F: Did you notice the icon of the doctor on each screen along with the speech bubble?
P3: Yes, i see that but it might be more clear if you mention, the doctor is saying so and so. Right now i see that icon but i cannot make the connection that it is the doctor saying something.
No other participant noticed that visual

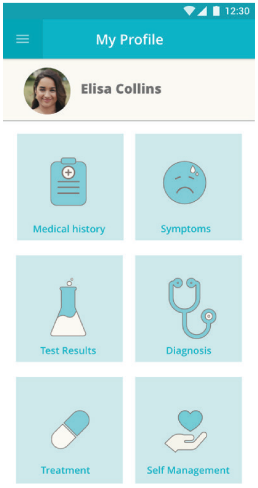
What was the participant's understanding of the eye icon which was meant to depict watched or unwatched videos.
P1: No I don't understand what it is for.
P3: No i don't understand it.
P4: No i don't understand it.
P5: I pressed it because i want to play the video
P6: Don't understand it.

F: What if instead of the icon I show the same using this (sketches out what it would look like)
The bar shows you how much of the video you have see.
P1, P3, P5, P6: Yes I think this is a better option. We don't know when the video will finish and if it moves from left to right it will be useful. In the third video the person is talking for too long. If you show the bar then you can show that the video will be finished soon.

How did the participants interact with the QnA section?
P1: (thought he had to answer the questions instead of selecting them for the doctor) So here it's asking me this question, how will i answer them?
P3: I see you've used the word 'Carbs' in one of the questions. If it is Sam, the persona, he is not going to know what Carbs is. There is also no sign for 'Carbs'. Maybe you can use a different word or explain what it means by giving examples.
P5: It is not clear that using this screen i can ask questions to the doctor.
P6: It seems to me that i am being asked these questions. I will answer them with a 'No'. Not clear that they are for the doctor.

Task 2

Participants depiction of the icons on the screen.



1.Information	2.Suffering
3.Lab	4.Doctor's info
5. Medica-tion	6. Take care of yourself

P1

1.Doctor will write something	2.My sickness
3.Lab?	4.Doctor's examination
5. Medica-tion	6. Heart or blood pressure

P2

1.Record	2.Symptoms
3.Lab results, research	4.Doctor's info
5. Medica-tion	6. Healing status, heartbeat

P3

1.First aid	2.person sweating
3.*Dont know*	4.Doctor will check you
5. Medica-tion	6. *Dont know*

P4

1.Commu-nicate in writing with doctor	2.Sick or stressed
3.Toilet	4.Exam-ination of sickness
5. Medica-tion	6. Heart pain

P5

1.Notepad for doctor	2.Telling doctor my sickness
3.Measure your tem-perature	4.Exam-ination by doctor
5. Medica-tion	6. Check heart beat

P6

Task 3

What did the participants think about selecting different Self management methods?
P1: I was a bit confused because when i press on yes i expect something to happen but it didn't.
If I press, then it has to go to the next screen automatically. If it goes directly to the next then the user might feel confused because they cannot see their selection. So we can ask them 'Are you sure?'.
When the user swipes back to re-check his selections, if the buttons are white, that could mean it's not yet selected. If the buttons are grey that means you have already selected it. If it's green that means it can still be clicked. You can use this to make it clearer
P2: It is very clear for me.
P3: For me it is clear, but for Sam (persona), i'm not sure if it might be confusing. It's can a bit confusing because its says click on the arrow and you think that the arrow is underneath, but it's not.
F: Where do you expect the arrow to be?
P3: It might help if the person signing can point to where the arrow will be placed. Small pictures can come up in the video to show which arrow to press and where. This method can also be used for yes and no buttons inside the video.
P4: It is a bit confusing. When i click on yes and no as i think it will lead to somewhere. But nothing happened.
F: I saw that you clicked yes on the lifestyle section, what would you have asked?
P6: How can i prevent myself from eating junk food.

Task 4

What did the participants think of the diet and food selection section?
P1:I like that you will be able to see the image of the food in the blue box. The portions of food are clear. Though if it's ice cream your measurement portions (in ml) will not work. Or cheese or butter, how will you know it's 100 ml? Perhaps you can use one scoop, 2 spoons or some measurement that we can understand. Also when you want someone to choose more than one use boxes with ticks inside like a checklist. When you want someone to select one out of all use circle with dot inside.
We drink tea and coffee with rusk, but tea and coffee is not part of dairy.

P2: It might be better to start with entering one's weight and then the doctor can tell you what you can eat.
P3: I like that there are pictures of everything you eat. I like this section because you can see what you select. I think it's good that you say the different meal tim-

ings first. It might be good to use clock hands instead of numbers because deaf people understand the visual.
P5: I choose the spinach and bread because it seems like i have to select an option. This section was not very clear to me.
P6: It is not clear that these are suggestions. Seems like i have to drink milk with every meal. It would be better if i saw the screen where you i can choose the food, before seeing the screens with the different suggested meal times.

Task 5

How was the participant's understanding of the smoking cessation and exercise section of the app?
P1: The green forward arrow in a semicircle is confusing. There could be a next button below this field.
P2: This was very clear for me
P3: For target weight am to type? Am i trying to gain weight or lose weight? I think overall the layout of the program is good and the idea is strong.
P4: It will be better if you can tell us in the SASL video where one should tap.
P5: This was clear. I would not change it.
P6: I was a bit confused with the green button so i thought i can press that to go back. Is would be better if the person signing gives instructions to tap on the correct typing field.

***Figure 26**: Patient persona used during usability testing.*

Appendix D

Observations and feedback after usability test:

Task1

1. The participants could easily tell what the phone transfer animation stood for. Although a suggestion was given to add the photo/icon of a doctor at the receiving end of the animation to make the transfer even more clear.
2. The subtitles in the videos were too fast compared to the signing, hence were distracting. Suggestion: The sentence on the video should change slower.
3. The green icon was not clear and instead a progress bar which shows how much video has been watched is much better
4. The background in all the information videos should be consistent. If it changes it can be distracting.
5. The size of the video of the person signing must be bigger.
6. None of the participants understood the concept of a conversation and speech bubbles and instead would prefer that space to be used to make the video larger. Another suggestion was to mention that 'the doctor is saying' on the screen before.
7. In the Q and A section, 4 out of 6 participants thought that the list of questions in the food section was to be answered by them. It was not clear to them that it should be selected.
8. The selection checkbox was not easily noticeable and participants tried to select the videos by tapping on the video itself.
9. 5 out of 6 participants chose to ask questions about food over medicine and lifestyle.
10. Carbs is not a word that every deaf person understands. It should be explained in the SASL video.

Task2

1. Most participants did not understand the icon for test results and self management. However two of the participants suggested some alternative signs. See Figure 2, 3 and 4.

Task3

1. While the selection of self management options was clear, each participant got a bit confused with the next arrow and there were too many CTA's.
2. Suggestions:
3. The person signing can say in the video where to click to go back and forth.
4. On clicking Yes or No the user should go to the next screen.
5. If going to the next screen doesn't allow the user to rethink their selection, there can be a screen that says, 'Are you sure?', before moving forward.
6. When the user swipes back to re-check his selections, if the buttons are white, that could mean it's not yet selected. If the buttons are grey that means you have already selected it. If it's green that means it can still be clicked.

Task4

1. Some participants did not understand the purpose of the 6 screens which show meal timings and meal suggestions. The concept got more clear to them after seeing the video which explains what healthy food is.
2. The participants thought that they had to choose one of the foods on the food suggestion screen. They did not realize that these were examples.
3. Suggestion: The order here can be different. The user can first see the video which explains what healthy food contains before seeing the plate diagrams.
4. The healthy meal screen and the meal timing can somehow be merged.
5. Instead of the time in digits, an image of a clock with hands can be used
6. The participant could select multiple food items was not always clear.
7. Suggestion: Using different type of check boxes. Checkboxes with tick, indicate you can choose many items whereas checkboxes with circle and a dot is it select one out of many items.
8. The participants really liked the concept of being able to see the foods and choose them.
9. The icon of the hand tapping worked well and it was very clear to the user that they had to tap a particular section.
10. The small downward facing arrow was misleading. They mistook it as a tappable button instead of an instruction that one can scroll.

Task5

1. In the smoking cessation section, the videos were clear but 3 out of 6 participants missed type field and instead tapped the next button.
2. Suggestion: The person signing could say that the user needs to tap on the ‘yellow type field’ or ‘yellow box’ to type the number. Just saying ‘type below’ does not help.
3. The type field could be made much more prominent. Alternatively the button to go next after typing can be separated from the type field.
4. The exercise section was understood clearly by all participants. This is because the instructions in the video to type current and target weight in the blue and yellow boxes were very clear to them.
5. A question was raised about whether the user is trying to lose weight or gain weight in order to type in the target weight.